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The Banff Regional Conference is intended for superintendents and trustees of medium-sized urban school districts in Canada's four western provinces. Some of the applications and limitations of electronic data processing were discussed at the 1968 conference. The following topics were covered in presentations: (1) A basic introduction to the concepts and terminology of electronic data processing; (2) a discussion of possible applications of computers in education, including school administration, research, computer as a subject, computer-assisted instruction, guidance by computer, library, simulations, and problem solving; (3) a discussion of regional data centers; and (4) current applications of electronic data processing in Canadian schools. A 90-entry bibliography is appended. (DE)

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1968

ELECTRONIC DATA PROCESSING IN SCHOOL SYSTEMS

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April 28, 29, 30, 1968

FOCUS ON DATA PROCESSING

Edited by

C.S. Bumbarger and D. Friesen

Arranged by
The Department of Educational Administration
Faculty of Education University of Alberta
Edmonton

**U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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CONFERENCE PLANNING AND ARRANGEMENTS

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FOREWORD

Originally the Banff Regional Conference was intended for superintendents and trustees of medium-sized urban school districts in the four western provinces of Canada. It was the conviction of the organizers that the medium-sized district offered the greatest potential for change and development since it is large enough to have the needed resources, but small enough to be flexible. Superintendents were invited because of their obvious interest in and responsibility for overall operation and development; but since superintendents work with and through boards, trustees too were invited so that they would bring the insights of informed laymen to bear upon the conference deliberations. The general format as originally employed has survived over the years.

The following are examples of major problem areas, that have been considered at this conference since its inception in 1959:

(a) Administrative staff organization;
(b) School finance;
(c) Continuing education;
(d) School-community relations;
(e) Educational planning.

Topics have changed from year to year as the specific interests and problems of participants have changed. Yet, in response to specific requests, the conference has several times taken a second look at topics previously studied.

The focus of the present conference--automatic data processing--grew out of the interest shown in it when it was touched upon in the previous year's discussions. The topic seems particularly appropriate since there is a great deal of discussion at present about computers, automation, computer storage and retrieval of information, computer-assisted instruction, etc. The whole field of electronic data processing is surrounded by an aura of mystery; to the average layman the topic is nearly incomprehensible.

Part of the purpose of this conference, then, was to dispel some of this mystery. It was intended to show, by the talks and discussions, some of the power, but also some of the limitations of electronic data processing, and to ask some of the questions about which school administrators must satisfy themselves before proceeding with application and installation. Questions about uses which medium-sized districts might make of these techniques, ways of cooperating with other authorities and ways of sharing facilities seemed particularly appropriate. Finally, the part to be played by Provincial Departments of Education in all this also seemed to need clarification.

School systems need a great deal of information. As they grow larger and more complex, they need even more and better information, for effective decision making depends upon it. Adequate data processing systems can help to provide it. The ready availability of information, however, does not relieve administrators of their responsibility to make appropriate judgements and decisions.

About what aspects of electronic data processing should superintendents and trustees be concerned and knowledgeable? It seems quite clear that neither superintendents nor trustees should try to become experts in either computer hardware or software. These are technical specializations requiring the competence of technical experts. But the superintendent must have some knowledge as to where these procedures might fit into his school system. He must know what the results of their introduction will be in terms of the overall effectiveness and efficiency of the operation. In short, he continues to be the generalist, concerned with overall programs and the matters that affect them. Trustees, also, need not be technical experts. Trustees do need to be sufficiently knowledgeable to deal effectively with policy questions as they arise.

It is from this point of view that the conference program was planned. Though no attempt was made to make technical experts of participants, it was anticipated that in discussion groups and in general forums individuals might get some help with the problems which they either face now, or expect to face in their school systems in the near future. The primary intent was to provide some of the information necessary to allow questions concerning data processing to be thoughtfully and wisely considered.

F. Enns
Professor of Educational
Administration

Introduction

An interesting question to pursue is simply, "Why should school districts give any attention at all to electronic data processing equipment and methods?" At first glance, there appears to be little argument for such an examination of this question.

Consider some points against the use of electronic data processing:

(1) It cost a substantial sum of money.
(2) It will not allow great savings in staffing expenditures.
(3) It will not reduce planning time.
(4) It may supply huge volumes of data requiring analysis.
(5) It necessitates the services of highly-trained personnel presently in short supply.
(6) It can't improve the quality of the data placed in the system.

All of these statements are, to a greater or lesser degree, true. Why then devote a conference to examination of such concept of questionable utility?

Among answers that might be given is this, "Because it can free us to do things we haven't yet been able to afford to do, things that may hold great promise for the improvement of the educational system." Paradoxically, the machine itself may allow us to put more of the human and less of the mechanical into the educational process.

For example, how many years of teacher training are really necessary to prepare an individual to maintain the register of attendance for a class? The sum total of man-hours devoted to this task by people trained for other tasks is frightening to contemplate. Similar examples are the placing of marks on report cards or checking and marking standardized tests. Not only can the computer perform such routinized tasks more rapidly than can humans, it can do so more accurately.

This type of task is only one small part of the picture. Probably everyone is familiar with computers used as accounting machines and for the storage and rapid retrieval of details of a business operation. Yet, too often the possibilities for planning inherent in the computer's capacity to rapidly manipulate masses of information is overlooked. Such varying bases are rarely utilized by school districts. Analysis of the school environment through use of the computer is seldom done.

That a large computer installation can provide a tremendous assist to the instructional program itself is well-known. What imaginative uses of this knowledge have been implemented? Might there be strong arguments for heavy expenditures to benefit the isolated schools in sparsely populated areas?

Another by-product results from the nature of the computer. It has been said that if we could give an intelligence test to a computer it couldn't score above idiot level. This carries real implications for the way in which instructions must be given to it. While extremely rapid in doing its work, it is not self-directing, except within limits established for it by man. This means that for educators to use the computer we must be able to clearly specify the problem, its relevant dimensions, the data to be employed and the manner in which the data is to be examined. Perhaps, after all, the major problem lies with us and not the machine.

In essence then, the major purpose of this conference was to examine the relevance of data processing to the current status of education and its application to the operation of school systems. The conference was viewed as exploratory in nature; subsequent activity in regard to data processing will be determined by the reactions of participants.

- Editors

ORIENTATION TO DATA PROCESSING

John Yusep

In planning the conference, it was decided that the diverse nature of occupations represented among the participants indicated that a presentation aimed at developing some common basis of understanding about data processing itself would be desireable. Such a presentation would deal with the nature of the concept involved, some of the terms in common usage, and examples of applications of data processing in educational settings. The goal was the establishment of a foundation for the presentations which would form the balance of the conference proceedings. Accordingly, John Yusep in the initial meeting of the conference devoted his session to orientation efforts.

-Ed.

I hope to cover two things in the next hour. First, I would like to run through a number of definitions. Next, I will describe two applications of data processing that are currently in use in our particular school, one on scheduling and the other on the class register.

The computer is supposed to solve everything. It is the magic box, at least this is the concept that most of us have. All you have to do is push a button and all the answers come out. I blame the manufacturers and the news media for this concept. I am sure most of you appreciate the fact that this is not at all the case, that there is a great deal of work involved in developing applications.

In a computer application one uses the idea of a system and sub-systems, which are two basic concepts. My presentation will deal with the example of a business organization but you will find that the same thing holds true in an educational application. A few of the systems or sub-systems may be cited for illustrative purposes, for example, the flow of information. In a business organization, information could be obtained through the sales department. This is then relayed to the accounting department. The production department will, in turn, relay the information to the purchasing department. The purchasing department will then relay this to the accounting department. This is an example of a flow, a system at work. Another illustration might concern supplies. The purchasing department will buy supplies from suppliers, the supplies will go to the stock room and information will move from the stock room to the purchasing department. Here, again, a built-in sub-system exists. That illustrates the idea of information flow. This, I think, will carry through in a computer application.

A manual information set-up might be compared with machine, punch card and electronic flow arrangements. In the manual system there is a hand-written invoice or order. This is hand-written again, (this might be the actual invoice or this might be the original bill and then the invoice). The processing will then be either by pencil and pad or mental calculation. The filing system will consist of the usual filing procedures, filing drawers, followed by output (again hand-written).

In a machine calculation operation, the typewriter creates the original document, the adding machine can be the input device, the calculator processes the data. Again the filing cabinet is available for storage. The output is the listing from the adding machine. One step beyond machine calculation is punch card application. From the source document, the information is transferred to a card by a card punch machine. It is possible to use other equipment, but in this example a sorter and collator may also be available. From these machines, the information is moved on, via the cards, to the reproducer. The reproducer enables development of storage in which special cabinets are available for cards. A printer can then produce information output from the cards. In an electronic application, tape may be the input format, but in all cases pretty much the same steps are followed. Whether tape or cards constitutes the input form (a converter can convert from card to tape), they can be the input to the central processing unit. This enables placement of material on tape or on cards, as the case may be, and again a printer provides output.

This is the data processing cycle. Originating with the source documents, the cycle proceeds through input, manipulation (classifying, calculating, recording, summarizing; the operations of the computer), and then culminates in output and storage, which can later become the source of new input. Certainly there are different methods of output and storage, it is simply that these steps are basic in the processing cycle.

What are some of the basic components of the computer system? There must be arrangements for input and output and there must be a central processing unit. This central processing unit can be divided into four distinct areas--the arithmetic or logic unit, the control unit, the storage unit, and the output unit. These are the components of the system.

Let's look at it again in a slightly different way by emphasizing some of the input-output media. For example, data used as input can be on cards or on tape. These can be used for either input or storage. In the case of output, printed reports, cards, or tapes can be obtained.

Certainly you have all seen data processing cards. The cards are similar regardless of the company producing them, the same basic principles are used. The card is a unit record, on the card certain basic information can be placed. Cards are designed with both "columns," the vertical dimension, and "rows", the horizontal dimension thus forming a grid or matrix. The card is divided into two sections, the top portion being the zone section and including rows 12, 11, and 0. The 0 is used for both the zone and the digit or lower section. In relation to cards, reference is quite often made to card fields. This means an area within the card, specified as particular columns, usually containing related data.

What information can be placed on the cards? Almost any data represented by digits, and here the digit section is used. If alphabetic information is to be recorded both the zone and the digit section are used. The alphabet requires two punches for each letter, one in the zone portion and one in the digit. Special characters may require two or three punches. Thus either digital or alphabetical information may be placed on a card.

There are some differences among tape machines. Each has particular characteristics, which will vary from machine to machine and from tape to tape. They vary not only in size but also in storage capacity.

To review very briefly what has been covered so far, each computer system is made up of certain components. There is input, a central processing section which includes storage, control and processor, and there is provision for output. Information moving through the system is "flowing." The flow can be charted to show significant points in the processing system through the use of specific symbols to develop the chart, or diagram, of the treatment of information in the system. Some symbol is placed at each action point; at each place where a decision must be made or there alternate routes are available.

Two terms, "computer hardware" and "computer software," are quite commonly used now. The machinery, such as the printer, the tape unit, storage unit, etc. is referred to as "hardware;" the actual gadgetry, so to speak, in an installation. The "software" refers to the program that will make the hardware operational.

All programming systems require software. This is the big problem in data processing. Data processing is well advanced as far as the capabilities of the hardware is concerned, but when it comes to the software, its development is time consuming. This is where a great deal of work must be done. In a very simple application, information may be on cards. Before this can be processed it will be necessary to put another deck of cards (part of the software) in the computer to convert the information on the cards to machine language, language that the computer can understand. This also instructs the machine in the operations to be applied to the data cards.

I think the best way to draw this together would be to examine the two educational applications mentioned previously; that is, scheduling and classroom registers. Before this information can be put through the computer a lot of preliminary work must be done, there must be careful planning and certain key things must be accomplished before an actual computer application can be put into use. For example, decisions on certain policy statements must be made. This step is very critical as far as registration is concerned. Educational programs to be offered must be determined. Feeder schools must be informed, not only of policy but also of programs. Finally, the registration form itself is very important, it is a basic information source. Steps are built in so that the student is in a position to make his selections, is enabled to complete a registration form properly. The onus is on the student to make the selection of the courses that he would like the following year. Once the completed registration form is available, it can be turned over to the data processing centre. The procedure is quite involved but I do think that it saves a great deal of time, not only teacher time, but a also administrator time, even though quite an educational process for personnel is involved. In the long run, in my opinion, the effort expended is well worth it in terms of results. Hours and hours of time are saved over the hand scheduling operation.

Once the registration form is completed the information is taken from the form and punched on the student request card. Then a course tally is run to indicate to the administration the number of classes required in each course. This tally shows how many classes are required and this, in turn, will tell how many English teachers are required, how many Mathematics teachers, and so on. It also provides a conflict matrix. It is necessary to find out how many students are selecting the same courses so that scheduling of these courses at the same time can be avoided. In other words, the tally and the conflict matrix are very useful in the development of the master schedule. From this information, the preliminary master schedule is constructed. There is a lot of hand work involved at this stage, but it is expected that someday the master schedule itself can be constructed by the machine.

Once the first draft of the master schedule is completed, the information is transferred to cards by running the master schedule card together with the student request cards. This provides a measure of how effective the schedule will be and also produces a listing of errors that have occurred. For example, if a student has selected a course that is not listed in the offerings this will show in the print-out. Or, if insufficient class space has been allowed for the number of students requesting English 10, that information will be supplied. A wealth of information is obtained that can be used in the next step in reconstructing the master schedule.

That first operation, as described, takes place at the end of June. In August, the program is run again with the scheduler in "schedule mode" and this time a confirmation of registration is produced. This confirmation is then sent out to each individual student indicating the courses that he has requested. Students are not told that they will in fact, get those courses but at least if they want to change, or if there are errors in the listing, they can report this to the school. At this point, corrections are coming from students and, in addition, new student registrations that come in during August are fed into the system. Again, the changes are punched and the master schedule adjusted.

At the end of August, the scheduler is run again in schedule mode and this time the print-out provides the required detailed information with individual student timetables, class lists, a complete updated master schedule and a listing of conflicts. This also provides course cards that are utilized in the progress reports issued two or three times a year. Furthermore, only partial schedules are provided for any students that have conflicts. Finally, a report listing students with irresolvable conflicts is produced. All this information comes from the computer. All that remains is a certain amount of hand scheduling.

It sounds good, doesn't it? The trouble is, on school opening day, things don't work just as smoothly as that. A number of problem conditions can develop. For example, on school opening day students come with their registrations, and there may be quite a number of "no shows." These are students who did not notify the school that they were not returning, therefore timetables were set for them. Again, there still are students coming in the first day of school wanting to register and no information about them is in the system. However, adjustments can be made by going through regular procedures and the new registrations and late registrations can be included as the master schedule is updated. In other words, deductions in one case and additions in another allow the same program to be run through the scheduler, and information for the new people is obtained. The people that registered properly and were able to pick up their materials will pick up their timetables, their fee and "I" card information, bus passes, lockers, and be given certain standardized tests. This is the information flow in process of development.

This application is beyond the experimental stage, in fact, Edmonton will have five high schools using this system in the 1968-1969 year. This system has been experimental for three years. During the first two years, a model 1620 computer was used but it was a cumbersome operation. Last year a 360 model 40 was used with satisfactory success. Snags were encountered but these were mainly manual problems. It is now ready for use.

The other computer application that we are using concerns the class register. This, incidentally, is still in the experimental stage. Most of you are surely familiar with class registers. What is being attempted is the elimination of all the hand operation involved. This is one of the time consuming jobs (and one of the clerical jobs) that teachers have and about which they complain. It is hoped this next year to cover our own school and in time develop a program such that we can recommend it to the system as a whole. A wealth of information can be derived from this application. In a sample of one department we used, there were eleven rooms and it worked very well. We started out by using cards and the teachers mark-sensed the cards. These were processed and then used to produce the class registers. This worked, but the cards were disappearing and there was difficulty in storing them and so on. The next step was a move to a scanning sheet.

Let me just run through the whole system to give you an idea of what is involved. For the first phase, the mark-sense sheet is in the classroom and, although there are individual sheets at the present time, it is planned to develop them in continuous form, joined together so they can be processed through the printer. There is a lot of information that can be preprinted on these sheets. There will also be a tearoff strip at the sides so that sheets can be bound and each home room teacher will then get sixteen sheets forming the day book that each will use. It will elimate a great deal of duplication as far as marking is concerned since this would be the only thing that they would have to mark. From this sheet, the information will be taken to a mark-sense reader which will automatically produce cards. Eventually it is hoped that the installation in the Edmonton system will be on tape, but at the moment cards will be used as the data carriers. The cards obtained from the processing of the mark-sense sheet, (consisting of student master cards, student attendance cards, and student cumulated attendance cards), are processed through a computer. The result, the print-out, is the register. The student master card will come through and go back to file, the student attendance card will go to file, while the student cumulated attendance card will come through and be destroyed but an updated cumulated card will be produced.

Now the register in this particular case will provide the following information: (1) grade, (2) late entry or early withdrawal (if the student starts late or if the student leaves early), (3) sex, (4) residence or non-residence, (5) student number, (6) student name, and (7) age--the year and month. The program will up-date age every month from the birthdate information. For each individual student, the percentage of attendance, total possible attendance, days absent, days present, and the number of lates, will be produced. In-addition to this detailed information, there will be a cumulative total, the days present, the days absent and number of lates. It is also possible to have a summary for the school, the room or the accounting population as well as a list indicating all students that enter late (with certain details) and students that have left early. Finally, a summary for the school as a whole is obtained. As I said, we are still developing this application.

To review, my main purpose in being here was to give you a bit of an idea of what is happening in our system and familiarize you with some of the terms. I couldn't hope to cover all of the terms involved in computer applications. I sincerely hope that through these illustrations my purpose has, to a moderate degree at least, been achieved.

COMPUTER APPLICATIONS IN EDUCATION

Dr. R. L. Bright

The keynote address for the conference was given by Dr. R. L. Bright, Associate Commissioner, Bureau of Research, U.S. Office of Education. The speech which follows provides first of all the meaning of data processing and the centrality of the computer. This is followed by illustrations of the significance of the computer in a number of professions and in education. It is necessary to see the computer not merely as a tool to do mathematical operations, but more as a machine capable of list processing or symbol comparison. The computer is capable of manipulating very complicated material at fantastic speeds.

Eight general applications of the computer in education are noted next. These are school administration, research, the computer as subject, computer assisted instruction, guidance by computer, library, simulations, and problem solving. In each of these areas numerous activities are already being carried out in various parts of the country. Some, of course, are more feasible at the moment, than others, but all have great potential for education in the future.

Dr. Bright ends his talk with a brief description of Regional Data Centers. He argues for the establishment of such centers and provides some ideas on their organization, their uses, and the pitfalls to guard against in their establishment.

-Ed.

I don't really know how adequately one can cover the application of computers to education in an hour, but I will try to examine a number of different fields in a very superficial manner, and go into further depth in the question period.

It may be of some interest to go back into the early history of computers, talking about, for example, the history of the IBM 650, which is one of the first two commercial computers, developed back in about 1952. The IBM Corporation made a very careful market study of the need for such computers. Their analysis indicated that probably fifty such machines could handle the entire computational load of the United States, and they couldn't see any need for more than fifty. However, somebody in IBM had enough nerve to decide that as long as they were going to set up a production line to make fifty computers they would tool it up and plan to build a hundred on the chance that other people would find uses for them. In the next three years, they sold over a thousand. There are now something in the vicinity of 45,000 computers in use in the United States. These, of course, cover a variety of fields. The first ones that many people think of are the applications in engineering and in the physical sciences, where they are used very extensively. Of course, they are used very extensively in business as well and here we usually think only of accounting.

I am reminded of a conference in which about fifty college presidents and industrial company presidents participated. After a talk, Dr. Herb Simon responded to a question from the audience in this way, " It is far easier to replace the vice-president of a corporation with a computer than it is to replace the operator of that bull-dozer," pointing out the window," the bull-dozer working on the hill out there." And this is indeed the fact. As the computers are invading more fields, the whole concept of automation changes. Many people think it is the unskilled people that are going to be replaced by automation. This has already happened to a very large extent. From now on, the higher your level of education and the higher your level of professional competence, the more likely you are to be replaced by a computer. It is very true for the corporation vice-president; the computer has already, in many cases, replaced at least one or two levels of middle management. We can see the computers invading many other areas, too. They are being used very extensively now for medical diagnosis, and I don't think it will be too many years before most of the diagnosis is done by computer, probably resulting in a far more thorough job than is ordinarily done by the doctor.

Often we are left with the impression that the computer is designed primarily to do mathematical processing, addition, subtraction, multiplication, and division, and that it can do this at such an astounding speed that it could do the same amount of computation that a man could with a desk calculator working for a year in a few minutes. Well, this is true, but computers aren't very often used for that. In almost all of the applications, with the exception of the engineering and physical science applications that I noted before, the machines are not doing arithmetic. They are doing what we would call list processing or symbol comparison. For example, if you take the telephone directory and ask for the number of the person who lives at 23 Highland Road, or something of this type, it would be a long job for a human being to complete. A computer--this would mean that the directory were in the computer--could scan through the whole book in a matter of a few seconds, or a minute at most even if you took all the telephones in Canada, to select one address. But note that this really isn't what most of us would call arithmetic. The machines are doing arithmetic less than 20% of the time in most cases. In many other installations they are doing arithmetic only 1% or 2% of the time. In other words, I think the biggest obstacle to the appreciation of what computers are is the name. They aren't primarily computers, they are symbol manipulators.

They can manipulate symbols in all sorts of ways, and compare symbols with each other. Actually, it turns out that the largest load on computers, in almost all installations, is language translation. So much for just a discussion of machines, and what they are. I would suggest that you forget that they are called computers and think of them just as symbol manipulators, devices that can manipulate very complicated lists at fantastic speeds.

Actually, coming to the field of education, I think there are eight major types of applications of computers. One of these, and only one, is school administration. You can probably break school administration down into four major categories: student records, personnel, finance, and facilities.

With regard to students, things that are often handled by computers are census information, enrolment, attendance records, grade reporting, permanent records, scheduling, and so on. I might mention a very interesting illustration here concerning scheduling. A frequent charge by students is that they are being reduced to numbers on IBM cards and that the use of the computer leads to impersonality. I am rather amused at this. Perhaps students have a legitimate reason for their position, but the reason above is not sufficient. Let me illustrate this by referring to one of the schools that uses one of the most sophisticated scheduling programs in existence today.

Here they are using very large computers so that they can schedule very quickly. Their procedure is that the students all come in and register in one day. There are no schedules made out ahead of time, no master schedules or anything like that. The students come in and indicate their registration, and then that night the whole campus is scheduled and the students get their schedules the next day. In this particular case, the students specify not only the courses they want to take, but also their first choice of professors. The machine that night schedules the entire campus, with three priorities. The first priority is the efficient utilization of the facilities, efficient loading of classrooms, laboratories, and so on. The second priority is to give the students, so far as possible, their first choice of professors. The third priority is the professor's preference for schedule. Note that it is just backwards from the way things are ordinarily done.

The results are very interesting. One, they are getting extremely efficient loading of their facilities. Second, the mathematics professor who indicated that he would prefer to have his class at 10:30 Monday, Wednesday and Friday, may the next day discover that he indeed does have a Mathematics class at 10:30 on Monday, at 2:00 on Thursday and at 9:00 on Saturday. But the other interesting thing is that the students get their first choice of professors 78% of the time, where under the old manual system on that same campus, the students got their first choice of professor only about 22% of the time. Is the computer impersonal or isn't it?

The personnel records, of course, include such things as payroll, personnel records, staff directories, retirement information, professional qualifications, and so on. The financial component sits on such things as budget preparations, accounts payable, cost accounting, purchasing, extended bookkeeping types of things. The facilities control can have inventory control, construction requirements, maintenance, transportation, cafeteria accounting, and so on. All of these are directly translatable into computer forms.

Under construction requirements, one of the most interesting ones to me again is the one at Purdue, where they have been planning their facilities using the computer. When they decide that they need a new building and they have drawings made of the building they will usually make three different modifications of the building plan with space divided up in a different way--office, classroom, laboratory and so on--so that they will have at least three different building designs. Then they take the student registration information from the previous year, add to it what kinds of increments they expect for the next few years, and then essentially utilize this student registration information in the planning of the building. (Of course, in the scheduling program I mentioned before that they have detailed information on all the facilities so that they get efficient facility utilization). When they plan a new building they feed the new building information into their facility data and then run a scheduling program where they reschedule the entire campus and see how much this new facility is utilized. They then repeat the whole process for the two other optional or tentative designs that they had made to find out which design is utilized most efficiently. On the basis of this, they usually get some ideas and make a couple of other tentative designs that they then plug in. With each tentative design they use, they completely reschedule the entire campus on the basis that this is the new increment of facility in order to find out how well that facility is utilized. They estimate that over the last five years they have saved about $28,000,000 in facility construction through the use of the more efficient facility utilization and design by this technique. Obviously this is something that would be absolutely impossible to even consider without an extremely large computer.

In respect to administration, I thought that it might be of interest to you to pick up some of the data out of one of the most recent studies made in the United States. This was a study made for the State of New York, a study made by the Systems Development Corporation, to analyze their computing needs and the feasibility of setting up regional computer centres to supply the schools of the State of New York. This included some 752 school districts. It did not include New York City, but it included all the rest of the state. Of the 752 school districts, 342 are now using data processing in some part of their administration. In other words, just under half. Just for information, census applications are done by computer by about 45%

of the school districts; attendance records, about 39%; grade reports, about 26%; payroll, about 25%; scheduling, about 23%; accounting, 10%; personnel records, 7%; inventory, only 2%. This gives some kind of an idea of what applications these different districts are utilizing.

The recommendation of this report was that they establish twelve regional centres to supply the computing needs of all 752 school districts, with three of these centres being bigger than the others--what they called evaluation and training centres--that had larger machines and which essentially were "mother" centres. There were also some centres peripheral to these, so that there were twelve centres altogether. Glancing over the material here, it appears that each centre would supply school districts having a total of somewhere between 100,000 and 200,000 students. The estimated cost of this service would amount to about $3.00 per pupil per year.

The second application of computers in education which I would like to discuss is research. This is one we ordinarily think of as mainly for universities. Today, incidentally, I am making no distinction between elementary, secondary and university education. Of course, computers are used very extensively in universities for all kinds of research, research in the physical sciences, in sociology, in the analysis of literature. One of the most recent uses was to analyze whether Homer was indeed the author of both the Iliad and the Odyssey. Research is a very important area of computer application and probably the largest one in education at the present time. Almost all major universities have computer installations of some kind or other for research applications today.

The third area about which I would like to talk is the computer as a subject area in itself, just the way we think of English, arithmetic, or history. If we think about some of the lists of applications that I gave before, it is very clear that the computer is making a major impact on all of the professions. It has already made major impacts in engineering and the physical sciences. It is now making major impacts in medicine, in law, in teaching, and any other profession that you can name. Thus probably the computer should be an integral part of any professional training. In fact a recent report, issued by the Office of Science and Technology, analyzed the use of computers in higher education. Part of that report states that even today any graduate of a four-year liberal arts college who has not become familiar with and had experience in the use of modern data processing techniques has been severely cheated educationally. As you look at all these various applications then you probably start thinking about the vocational possibilities here, anywhere from maintenance people to programmers to systems analysts and application specialists of all kinds. It is very clear that many of these do not require a college education. If students were vocationally oriented toward computers, high school education is quite adequate. I think that it is clear that this is one of the most rapidly expanding vocational areas. If you have tried to hire any people in the field of data processing recently you know of the extreme shortages that exist. It is an area which almost all vocational schools, or comprehensive high schools with vocational components, should be seriously considering.

There is also a third area here that is important. I think the last half of the century is going to belong to the computer. I would argue that if any kind of a device is going to have this kind of impact, the average citizen certainly should know enough about it to be able to make a reasonable stab at separating fact from fantasy. He should know enough about these devices so that he doesn't have unreasonable fears as to their intrusion upon his life and yet know enough about them so that he knows when these fears are realistic, some of the invasion of privacy features, for example. On this basis, I would argue that I think we very seriously should ask ourselves whether every high school graduate should not have had experience in and opportunity for the use of modern data processing equipment. I think they should. It is something that we should be thinking about, and see how soon such a thing might be feasible.

In tackling this question, one thing we have done recently, just in the last year or so in the Bureau of Research, is to let some contracts to look at what would be the economic feasibility of creating a regional centre to supply sufficient computing services to all of the secondary schools and all of the four-year colleges in an area serving a total of some 100,000 to 200,000 students each, so that all of these students could have courses in programming and so that all of these students could regularly use the computer as a tool for solving realistic problems in all of their courses, whether they are physics, English, mathematics, or business. The analysis turned out to be very different than many people had expected. Most people would have just thrown up their hands and said, "Oh, this is absolutely nonsense to even think about such a thing. It would run into hundreds of dollars per student." And indeed it does if you do it by the conventional way. Here I might argue that one of the troubles not only in the computer field but in almost all hardware fields where hardware has been used in education, is that the hardware used was originally developed for something else so that it doesn't work very well for education. There is very little hardware designed for use in education. One of the real problems then is to get the information into the computer.

We are using page readers to collect data from school systems and colleges all over the country and hundreds of thousands of pages per year come in in typewritten form. Just the reader alone costs about $700,000 a year, so it isn't a feasible thing to use in a local school system. One of the big questions remaining at the local level is, "How do you get information in?" We have been looking at some of the mark-sense type of things. They look like IBM cards but essentially they read black lines on these cards. You can use black lines for the appropriate places on the cards for letters, numbers, punctuation and so on. The student can do this work at home or at his desk or anywhere and bring the deck of cards in and feed them into a photo-electric reader and then into the machine. This kind of a terminal looks very attractive. What we are thinking of here is essentially a scanning card reader that will read about 200 cards per minute and a teletype electronic printer (a printer just on the market) which will print about 200 characters per second. We would have one such terminal located in every secondary school of 2,000 students or less. One terminal, we estimate, could handle about 2,000 students. In about two minutes after the student hands his deck in, he will get the print-out back. The cost of such a system works out to be about $10.00 per student per year. It is still high, but it certainly isn't, I think, anywhere near the range that most people thought. And I would argue that this is probably within economic reason if, indeed, schools do decide they want it. If it is important to give a course of this type, I think this is not an unreasonable cost at all.

Incidentally, the question always comes up whether you want small computers in the schools or whether you want a big computer in the region. It used to be years ago that the bigger the machine you got, the more computations per second per dollar you would get. This isn't true anymore. The small machines are just as efficient in this kind of a measure as the large machines. The difference is primarily in the amount of memory you can afford and this is closely related to the number of languages that you can use. (Remember, I said that there are different languages that are convenient for people to use to converse with machines.) With a small machine you can generally afford to have only one language in it at a time, so that you can't mix people using different languages. In large machines you can have many languages available for all different types of users. So this central system I am talking about would probably have a half dozen languages available and students could be writing in these completely interchangeably. Also, it turns out that you need a large machine to give this very efficient turn-around type of thing I was talking about--put a program in it and get it back in two minutes.

A fourth application to education is the instructional use of the computer, often called, in some types of it at least, computer-aided instruction. This is where the student may be seated at a typewriter console with a television display in front of him and with a loudspeaker that can talk to him and ask him questions which he can answer either by typing on the keyboard or by taking a pointer and pointing to something on the T.V. tube. The computer can then detect where he is pointing and use this information. There is a lot of research going on in this kind of application in many different subject areas.

Another very attractive application is the teaching of languages. Stanford University this year is giving its entire introductory course in Russian by machine; there are no teachers involved at all. The teachers don't like to teach these introductory courses anyway. They would rather spend their time on the literature courses and area study courses and things of this type in the third or fourth year of the program. It is very clear that the three major economies in the world by most projections for the year 2000 are the North American, the Russian, and the Japanese. I think it is going to become more and more essential that we teach Russian and Japanese. And I might ask you how many instructors do you have capable or qualified to teach either one? Another very attractive feature of the computer is that you can teach a different language just by changing the tape.

A third attractive area for C.A.I. is in teaching adult literacy or retraining of adults, oddly enough because of its impersonality. One of the major problems in adult literacy training or retraining is that adults simply will not sit in a classroom where they are forced to exhibit their ignorance before their peers. On the other hand, they have no reluctance at all to sit down at a terminal and interact with the computer. No one else in the class knows what they are doing and they aren't even apparently concerned with the fact that the teacher has information that she can find out. But essentially we find that people of this type who will not tolerate a classroom situation at all will relate very well to computer terminals. Thus C.A.I has a number of interesting applications.

The cost at the present time is for a loaded system. Of course, with any kind of system that has high hardware costs you have to keep it loaded if it is to be economically feasible at all. The systems that are available today, if you keep them reasonably loaded throughout the school day, work out to costs of somewhere between $1.50 to $4.00 per student hour. This is in contrast to your standard instructional costs of about 25 to 35 cents per student hour. So the answer is, "No, they are not economically feasible yet." I think they may be in a few years. It depends upon how much development is done on them. Some of these, even at costs of around $2.50 an hour, can probably prove themselves at the university level but I don't want to encourage you to all run out and start putting C.A.I. systems in your elementary and secondary schools at the moment. It is something you should watch for five or six years from now. Certainly I don't think it makes any sense at the moment for general use, although it is a very intriguing research area. One can do spectacular things with it.

There is another area though, which we call C.M.I., computer monitored instruction. The place that this is developed to the highest degree as far as I know, is at the New York Institute of Technology out on Long Island, a four year technical and engineering school. Here the students--and there are several thousand students on the system--use it in several different courses. These include, I think, a couple of the humanities, and also mathematics, and electronics. The students study on their own, completely independently, from the standard college textbooks--in other words, the system assumes that kids can learn by reading--and at the end of each unit they take a multiple-choice test which they take by blackening squares on a standard test form which they then feed into a photoscanner which gulps it into the computer. The computer then does three things: One, on each student's record it indicates the questions which he missed. The computer program also has built in quite a bit of information about the characteristics of each question so that the computer correlates the characteristics of each question the student missed with the characteristics of the questions that the student has missed for the previous six weeks to try to detect a pattern of difficulty. If it detects such a pattern it indicates this on the student record for the benefit of the adviser who reviews these every week or two.

The second thing the computer does is to up-date the curriculum file in the sense that it indicates not only the number of students who missed each question on the test but also the characteristics of the students who missed each question. At the end of the semester the faculty have detailed information about the types of students that had difficulty with the different problems on the tests.

The third thing, and the only one which is really of immediate interest to the student, occurs about thirty seconds after he puts his test paper in; he gets a print-out from the printer right beside it, which lists each question he missed. Then on the assumption that the standard text wasn't clear to that particular student on that particular topic, it will give him the name of three other standard texts that are in the college library along with the page numbers in those texts in which the same subject material is covered. If he got an 85% or less, he is required to go and look up the references and take a separate test on that unit. If he got an 85 or higher, the machine will give him the next assignment. Now this is a system which is a self-instructional system, an individualized system in that the students are all going at their own speed completely independently of anyone else. I might say I don't think I would endorse an educational program that had this alone. In addition to that there are discussion groups and things of this type that can do some of the things that technology can't. That is a separate talk in itself. But suffice it to say that the computer application here is an extremely interesting one in that it provides a means for really keeping track of large numbers of students, each one going at his own speed through material. And note that it takes something on the order of maybe ten seconds of computer time per student per week rather than the continuous interaction that C.A.I. itself takes, so that C.M.I., computer monitored instruction, is very inexpensive by comparison. The type of regional centre I talked about before could easily handle this in addition to the school administration and the student uses.

Computers can be used at all grade levels; there is a lot going on in the U.S. now on the individualization of instruction at the elementary school level. We have a number of elementary schools where the instruction is completely individualized, students are going through the materials at their own speeds, completely independently of anyone else in the class. In most of these schools there are a number of teacher aides now who are, in effect, doing the same kind of thing I just described, giving tests, grading tests, finding out where the students are, and so on. Again, we are computerizing that part of the program in a way very similar to the university application I just mentioned. It is almost an identical application of C.M.I. to the elementary school and I think that this will become very common in the United States over the next ten years.

The computer is ideally suited for multiple-choice testing, of course, where you can scan things with a photo-scanner and do all kinds of automatic testing, test analyses, and grading. In addition to this you can have other types of testing; for example, where the printing is in red and you underline in black or something and run it through a photo-scanner. The computer can easily detect which sections were underlined.

The computer is also being used for grading compositions, even though this use is not yet practical for high schools. But again, ten years from now that situation might be very different. We might be routinely using computers for grading English composition.

✓ A fifth major application for computers, I think, will be in the guidance function. We have at least three major research and development activities going on now utilizing the computer for the guidance function in two different senses. One sense is teaching the students how to make decisions, how to use information, and what kind of information to ask for. The second sense is in assisting the student in making decisions, supplying him information about different vocations, different professions, correlating this against the student's interests and performance, pointing out where he is a good fit, pointing out where he is a poor fit, suggesting other vocational areas that seem to fit his interests and aptitudes, pointing out to him what people in these vocations do, all these kinds of things are being done by computer. It is still in a research stage, but we will have it operational in a few schools next year, and again this looks like a very attractive area for computers in schools within the next ten years.

✓ A sixth application is in the library. Here I am thinking of things considerably more sophisticated. There are really two functions for the normal library. One we can call document identification and the other document retrieval. Document identification refers to the identification of a document that you want to obtain in the first place. At the moment it is technically possible but not economically feasible to transmit the documents themselves electronically. Once the document is identified you could either go into your library and get it or just type an order on the teletype and have it mailed to you. This type of document identification is becoming important. It is already in use in some of the medical fields. As I say, we expect to have it operational in about a year in education itself. Another type of library application it a much more general concept of information retrieval where you simply ask the question you want answered. This is getting into some of the more far-out research applications but there is some work going on. Some of the more extensive things have been done on baseball. You might ask for example, "How many games did the Yankees win by three runs in 1965 in their home field?" In a fraction of a second you would get the answer. We find that a number of management information systems in large industries are being organized in this way so that you can ask questions in English. You cannot do this verbally yet, but you can type in questions about data in your personnel records. For example, "How many people with less than five years experience are earning more than $18,000 a year?" Type this in as a question and then you will get the answer back. This kind of question and answer mode is becoming quite possible and feasible in certain areas. The question still has to be quite simple, in other words, very simple sequences of simple grammatical structures. In education you can ask such things as, "How many people with more than three years experience and only a B.S. degree are earning more than $18,000 a year?"

It has been the ambition of a lot of people to develop a teletype system where you could type in German and have Russian come out at the other end, and vice versa. There has been a lot of work on this kind of thing and the translations actually are pretty good, but far from perfect. It is the long term ambition of people to get a telephone system where you can talk into one end in English and it will come out the other end in Russian, and vice versa. We may see this before the end of the century--I am not sure. But at any rate, if the questions are simple the machines can handle them very well, and it is possible to set up an information retrieval system of this type which answers questions directly.

The seventh computer application is that of simulation. This is essentially where we use computers to simulate some other process. We use them to simulate airplanes in the design of aircraft. We use them to simulate elevator banks, and the random distribution and demands of people, in designing elevators. But you can use them in educational ways very profitably too; for example, you can use a computer to set up and simulate the mercantile system in the sixteenth and seventeenth centuries.

One of my friends is an historian who actually majored in the history of that period. He had an opportunity to play with a game which simulated this period in a computer game. He got so intrigued he sat down and played with it for about two hours and came away just amazed. He said that he had specialized in the area, yet there were a number of disconnected events that he hadn't been able to associate. After playing with this game for an hour or so he realized that all of these events followed directly as consequences of the mercantile system. If you tried to do something else, something peculiar happened that would change the balance and force it in the direction that it actually went. So he said that in that hour of playing with this game he really felt he had learned more about history than he had in his last two years of graduate study.

We find that games are frequently used in the training of management people in industry. They have all kinds of management games, essentially to train managers in the economics of competition, if you will

They are also training medical people in diagnosis this way. We have one program where we are using a dummy of a human being for training anesthesiologists. If they do the wrong thing the heart will stop or the blood pressure will go up or the thing will even vomit. Anesthesiologists can be trained in a much safer way than having them work on patients.

We are using simulation in some cases on an experimental basis in the elementary school for training in the basic concepts of economics, and profit and loss in the operation of a store. So that even at the elementary school level I think that simulation as a use of the computer will be a very valuable educational tool. At this time it is also still in the research area.

The eighth and last area is one I have alluded to a little bit already. I call this the problem-solving or the design tool use. We see that almost all modern engineering designs, whether we are talking about computers or rockets or bridges or what, are done by computer. The engineers use the computer very extensively in making these designs. Even in modern architecture we are going more and more toward computers where there will be a display of the floor plan on the T.V. tube. The architect can change things around by a pencil with which he can draw lines and move doors and things like that. He can juggle the thing around in any kind of a disign he wants. He can then just push a button and the computer will proceed to make final drawings of this, including all of the structural members, cost estimates, etc.

Well, if indeed the engineers and architects are doing this when they actually go to work for an industrial concern, shouldn't they be trained that way when they are in school? This is particularly true with the university again, and certainly we should be using the computer as a tool in the university, training students to use these tools in the same way they will after they graduate. I think the same thing can be extrapolated down into the high school as we train students to use the computer as a problem-solving tool. I think we can find very realistic problems in any course in the high school curriculum where, with the computer, they can solve problems of a nature that nobody would ever think of assigning in the old technology of pen and pencil.

This then covers very briefly what I would say are the eight major types of applications of computers and how computers impinge on education. I would like to just comment on some regional considerations again. Should the individual school districts have computers? Should you go to the regional concept and not try to develop data processing independently? Where are you going to get the personnel for it? The extensive programming involved requires specialized people. These are high salaried and in extremely great demand. Generally you are not going to get them, you are not going to get people that can do a good job, if you try to do it in every separate school district. I would also argue that the sheer economics of it and the things that you can do with the larger machines are so attractive that it makes sense to see what you can do with a large machine rather than with a small machine.

What are the problems that you run into when you go to such regional use? One of them, and I think the most important one, is that you need a fairly high degree of standardization if you are indeed to realize the economies that are possible. That doesn't mean that every school district has to do things in exactly the same way. You do have to have a standardization of input if you are really to achieve the effect you want. Particularly, you need a standardization of definitions. For example, if you are going to feed in the number of handicapped students you have, you had better make sure that all the schools are using the same definition of handicapped. If they are going to feed in the number of children that are below grade level in reading, you'd better have a standardized definition of determining if a student is below grade level in reading. In other words, if you are really going to collect data of this type that is going to have any value in comparison of one school with another you need standardized definitions. You also need very standardized file structures, but this is something that really is a major concern of the regional centre. The manner of storing data in the files will affect the kind of data that is going to be collected and transmitted. Now every school district would not have to collect all of the data and transmit all of the data, but essentially the type of data they do collect and transmit should have been anticipated and should be handled in a standard way in this file structure. Once you have the file structure established and the data fed in, it is very simple to get it out in any different kind of form you want. In other words, standardization here doesn't mean that you have to standardize on output forms. You can have a wide variation there without any cost differential. You do have to have quite a bit of standardization on input.

Here again, the question is how does this relate to the independence of school districts? We'd like to say in our particular case that we never get involved in school districts at all insofar as what they teach and when they teach it and how they teach it and who teaches it. I think the same thing applies to a regional centre. It is clear that the type of administrative services we are talking about affect none of these things. I don't see how in any sense it is any restriction at all on the individuality of school systems. The only possible problem here would relate to the privacy of the files and provisions can be made for this, essentially with a joint agreement. You would need certain key words, in other words you need "lock combinations", to get to different files so that you can maintain privacy of the files if you wish.

I would argue that the elementary and secondary school systems should not be considered independently of higher education for a very interesting reason, I don't think that the universities can conceivably afford the computers they need for research use on their own. The only way they will get the power for their major research problems is by using this regional elementary secondary computer at night. In other words, it is just the opposite of the tendency in many cases now where they are sort of using the university computer to service the elementary and secondary schools. If, indeed, we get into the area where we are supplying computer services to all of the secondary students in those schools, the computers are going to be so powerful that they will be able to do the university research problems at night with no difficulty at all and I don't see any way in which most universities are going to be able to afford the computer that they need in any other way. And, incidentally, in addition to handling programming courses for the secondary school students the computer could handle this for the undergraduate students in the university equally easily. I don't think this alone will satisfy all of the university requirements.

There are a lot of other specialized requirements that universities may have, but there is another technological breakthrough coming along at the same time, and that is the communications satellite. It may turn out that the major effect of the satellite so far as education is concerned, I believe, is going to be the fact that with it long distance telephone calls will become independent of distance once you get over perhaps 600 miles. Thus we may not have to think of one computer centre supplying all possible computer services to a university. In other words, in a few years when we get the satellite up, it is going to be just as cheap for the University at Edmonton to tie into a university computer at Los Angeles or in Boston as it would be for them to tie into a centre only five or six hundred miles away. So that for some of the specialized services such as the design functions they need they may tie into a computer in Boston, while for medical services they may tie into a computer in Los Angeles and for information retrieval in the physical sciences they may tie into one in Montreal. I can see that they would be tying into many different ones for some of the specialized services. But I see that the great bulk of their work, the major part of the student use, the administration and their research could very easily be handled by a regional centre of the same type we are talking about for supplying the elementary and secondary school system.

The last point I would like to make is one that you shouldn't overlook in any of your planning. That is, don't fall into the trap that you think the cost of the system is the quote that you get from IBM or RCA or G.E. or something on the equipment. It turns out in every computer centre that I know of in education or anywhere else, the equipment cost or the rental of the equipment is about one-half of the cost of the operating system. In other words, the personnel costs are in almost all cases very nearly equal to the equipment costs. If you plan a computer installation and if you find the power of the computer that is recommended and what its rental cost would be, figure that you are going to have an equal cost for personnel, operating personnel, and programming personnel to keep that centre going.

DATA PROCESSING IN CANADIAN SCHOOL DISTRICTS--
REPORT OF A SURVEY

D. Hemphill

A brief description of automatic data processing in Canadian education is provided by David Hemphill, graduate student in Edcuational Administration at the University of Alberta. He reports on his own research project carried out in 1966.

The use of automatic data processing varies greatly in Canadian school systems. The districts using A. D. P. were, on the average, large and urban. The charge that data processing systems are too expensive does not receive much support in the research data. As an appraisal of the status of data processing in education in Canada in 1966, this report provides a valuable bit of baseline evidence against which future developments can be compared.

-Ed.

I would like to begin with a quotation taken from a paper by Wilfred Brown, "It is paradoxical that the educational enterprise, which has played a leading role in the advance of science, technology, and economic growth, has itself been isolated from and highly resistant to general improvements in instruction and methods which many of these advances would permit if adapted to the school system." He is saying that we are educators, we produce this society that is advancing very rapidly in technology, and yet the educational system hasn't appeared to keep up with the technology. The focus in his paper was mainly on instructional methods, but I think it applies to school administration as well. Therefore, I attempted to find out to what extent data processing was used in Canadian school districts and what characteristics differentiated between those districts that were using data processing and those that were not. I used the phrase "automatic data processing" in preference to "electronic" because there are some mechanical kinds of data processing hardware. I also placed both electronic and mechanical, for want of a better name, into what I called "automatic data processing." I hope that those of you who have already seen some of the reports of the study will bear with me while I summarize it quite briefly.

The first focus was to find out the extent to which data processing was used. For this, as data sources, I relied on the Departments of Education for the ten provinces and a mailed questionnaire to identify districts using data processing. Some of you were kind enough to return the questionnaires to me.

The focus was on medium and large school districts. The only districts contacted for the study were those that had 2000 or more pupils in grades 9 - 12. Now this may exclude in size some of the districts which you people represent, but I felt that it was necessary to deal with a limited number of districts and by using this criterion, 2000 or more pupils in grades 9 - 12, I had 103 districts across Canada which seemed like a reasonable sample size. Questionnaires which has check-lists of various kinds of data processing operations and which asked for information about personnel, district size, and the community, were mailed.

In the first part of my report, I would like to indicate by using the overhead projector some of the operations that were being conducted in 58 of the 103 districts. I feel that the 58 that returned the questionnaire were a pretty good representation of the 103 districts. Of those 58 there were 14 who indicated that they were using data processing to some extent. That represents about 24% of my final sample. This percentage is half of that found in New York State where approximately 50% of the districts used some form of data processing. I gathered these data in the spring of 1966 and even though the situation may have changed significantly since then, I think it is representative of the beginnings of data processing across Canada.

Now the check lists that were sent out asked for information about two kinds of accounting operations, business accounting and pupil accounting. I limited what I wanted to investigate to central office operations and broke those down into business accounting operations and pupil accounting operations. Table 1 shows you the business accounting operations that are performed with A.D.P. by this group of 14 districts. There were twenty operations on the check list plus a provision for any additional operations which could be written in by the respondents. Basically they fell within the four areas of educational data that Dr. Bright has mentioned. You will see that ten of the districts were doing payroll and tax deduction forms and eight were doing pension records. Then there was another group of operations which were essentially budgeting, and cost analysis. There was yet another group which related essentially to facilities. Now there were not very many of the fourteen districts really involved in anything but personnel and payroll operations and those things associated with payroll, such as deductions, federation fees, and pension records. Within the fourteen districts there was an aggregate of 87 district operations carried out by computer.

TABLE I

NUMBER OF DISTRICTS PERFORMING BUSINESS ACCOUNTING OPERATIONS ON ADP EQUIPMENT

Operation	Number of Districts
Payroll	10
T-4 forms	10
Pension records	8
General ledger	7
Accounts payable	5
Cash receipts	5
Cash payments	4
Trial balance	4
Expense ledger	4
Personnel records	4
Inventory (supplies)	4
Federation fees	3
Maintenance records	3
Budgeting	3
Cost analysis	2
Inventory (equipment)	2
Purchasing	2
Transportation	1
Bonds (debentures)	1
Textbooks	1
Other	4
Total	87

TABLE II

NUMBER OF DISTRICTS PERFORMING PUPIL ACCOUNTING OPERATIONS ON ADP EQUIPMENT

Operation	Number of Districts
Grade reporting	6
Enrolment statistics	5
Test results	5
Honors lists	5
Attendance	4
Grade distribution	4
Test marking	4
Failure lists	4
Class lists	4
Course choice tallies	3
Mailing and addressing	3
Conflict matrix	2
Student scheduling	2
Class ranks	2
Permanent records	1
Eligibility reports	1
Personality profiles	1
Teacher scheduling	1
Room scheduling	1
Library records	1
Other	3
Total	62

For the second classification, student accounting operations, I had constructed from my own knowledge of school administration and from reading some of the literature, a group of twenty different pupil accounting operations, which I felt had been done in the past on automatic equipment and which it would be reasonable to expect some districts would be performing on automatic equipment. Essentially, these break down into two main areas; the attendance and grade reporting areas and class scheduling, plus a number of other rather miscellaneous things. As shown in Table II the most frequently performed operations in pupil accounting were those related to enrolment, statistics, and grade marking, reporting and distributions. I was surprised at the few districts who were doing anything at all on class scheduling which is time consuming when done manually. There are few districts actually trying this with automatic equipment. In the whole area of student accounting, there were 62 operations compared to 87 in business operations. The main uses were in attendance, examination marking, recording and reporting, with some secondary use in student scheduling.

To see how districts were themselves becoming involved in these kinds of operations, I obtained information indicating computer uses in the fourteen districts. These are summarized in Table III. I won't identify the districts because their operations may have changed considerably in the past two years. The number of uses by individual districts ranged from two to twenty-nine.

You can draw some conclusions from this. First of all, there seems to be more general use of business accounting operations than pupil accounting operations. I didn't get any data to indicate whether or not it took more time or cost more money to do these than the pupil accounting, all I was interested in at that time was the type of operation and whether or not it was being done on automatic equipment. Although there are some exceptions, most of the districts were performing more business than pupil accounting operations. While three

TABLE III

BUSINESS AND PUPIL ACCOUNTING OPERATIONS, BY DISTRICT

District	Business Operations	Pupil Operations	Total
A	9	20	29
B	17	10	27
C	13	9	22
D	10	4	14
E	5	6	11
F	9	0	9
G	8	0	8
H	5	2	7
I	5	1	6
J	0	5	5
K	4	0	4
L	0	3	3
M	2	0	2
N	0	2	2
Total	87	62	149

districts used the computer more for pupil accounting than for business, in the sample as a whole more business than pupil accounting operations were clearly in use. This seems reasonable to me because the programs needed to do the business accounting have been developed in business and industry, and we are in the process of adopting them and adapting them to educational use. It takes more time to develop the programs for the kinds of pupil accounting operations that can be performed since they are more specific to education. Yet, in the final analysis, the business accounting operations are really only supportive operations to the main objectives of the educational system. I would suggest, therefore, that we need to do some other things to help increase the usefulness of the hardware by developing more software to handle these pupil accounting operations. Perhaps one way this could be done would be to train educators in the techniques of A.D.P. and then give them the time to develop the software. On the other hand, we could train data processors in the problems of education and then give them the time, facilities and resources to work with educators to develop the kinds of software that we need. This is a very brief review of the first part of the study, the survey of the use of A.D.P.

The second aim of the study was to compare districts that were using A.D.P. and those that were not. Five main categories of characteristics were used to compare user and non-user districts. The age and the amount of education for both the superintendent and business administrator (the latter was the number of formal years beyond high school), the recency of education (which again was the number of years since a formal academic course), the tenure (the number of years within the present position), and the mobility (the number of different organizations in which the individual had worked in his four previous positions). For example, someone who had worked his way up in the district as teacher, vice-principal and principal to superintendent, would have a "1" as his mobility score because his four most recent positions were with that same district. On the other hand, a business administrator might have been in an industrial firm and then moved to another school district and finally to the current one as an accountant and finally to his present position as the secretary-treasurer. In this example he would have been in three different organizations in his four most recent positions. Another list of information gathered was the number of professional journals, which was the number of professional journals that were regularly read. Now I know that many of us subscribe to things that we don't always get time to read so I asked for the number that were regularly read, not the number to which subscriptions were held. Characteristics of the districts were also identified. Table IV presents a summary of these data.

Perhaps I should explain why I took both total enrolment and grade 9 enrolment. You will recall that when I chose the sample I was looking mainly at secondary grades, 2000 pupils grades 9 - 12. In this way I got secondary districts, such as in Ontario where there are Collegiate Boards. In other provinces, other terms are used to define school units. So there were some that I called unified which ran grades K to 12, 1 to 12, K to 13, and there were some with only the secondary school grades. I excluded elementary districts from the sample, (those which were purely elementary, or as called in some provinces, the public school districts).

The total instructional staff included all the professional educators in the district, including teachers, school administrators and the instructional administrators in central office. The percent of the staff that was male was computed. Mean experience of staff was the mean number of years teaching experience for the total staff. Mean education of staff dealt with post-secondary education. The pupil-staff ratio was computed and the expenditure per pupil was the operating costs per pupil per year for the most recent fiscal year.

Other data were about the board members, their ages, the number of years as board members, and an occupation index taken from a sociological scale defining six classes in terms of the amount of education and salary, based on the 1961 census data. When I took the board as

TABLE IV

COMPARISON OF USER AND NON-USER DISTRICTS

Characteristic	User Mean	Non-user Mean
Superintendent		
Age	55.0	53.1
Amount of education	6.1	6.3
Recency of education	14.0	14.5
Tenure	7.4	7.2
Mobility	2.1	2.6
Professional journals	5.5	5.0
Business Administrator		
Age	48.2	47.6
Amount of education	3.7	3.0
Recency of education	18.6	20.9
Tenure	8.8	9.1
Mobility*	1.6	2.7
Professional journals	3.9	3.7
District		
Total enrolment*	40,443.4	10,248.9
Gr. 9 enrolment*	3,309.5	1,218.5
Total inst. staff*	1,813.0	447.1
Pct. staff male	39.3	48.4
Mean exp. of staff	7.8	8.2
Mean educ. of staff	3.5	3.3
Pupil-staff ratio	22.4	22.3
Expend. per pupil	489.7	483.6
Board members		
Age	49.1	49.6
Tenure	6.7	5.7
Occupation index	64.5	62.4
Board		
Number of members*	11.9	9.0
Mean age of members	50.3	49.6
Mean tenure of members	6.3	5.7
Mean occ. index	64.4	62.5
Pct. members male	86.9	84.3
Pct. members elected	71.0	78.0

*Significantly different at the 5 per cent level of probability.

a whole I had number of members, mean age of members, mean tenure, occupation index, percent of members male and percent of members elected. This is quite a number of variables, granted that they are rather objective in nature, but because it was a relatively small study I have looked at these things.

I don't think I will mention any comparisons made other than those where there was a large difference. They were the ones related to district size; the total enrolment, Grade 9 enrolment, and total instructional staff. The districts using A.D.P. were larger, on the average, than those that did not use A.D.P. The mobility of the business administrator was higher in the non-user districts. It might mean that the larger districts tend to bring their secretary-treasurers or business administrators up from other levels within the district, because the indication is that they moved around more when they were in non-user districts.

There was another group of variables I looked at as well but they were categories and I'll just present the information briefly. The districts were broken down in terms of their enrolment type, unified and secondary, public and denomination; and community type, metropolitan, non-metropolitan. Metropolitan area school districts were those in the metro areas of 100,000 population or greater, which at that time included 15 areas. Regina was the smallest and it went up from there. The only set of categories where there was a significant difference between those that used A.D.P. and those that didn't was in the community type, those in the metropolitan areas tended to use A.D.P. more than those that weren't.

I wish to draw a couple of conclusions from this second part of the study. The most significant factor, of course, was district size. Maybe you say this is a lot of work to go through just to prove that the bigger districts used A.D.P. and the smaller ones didn't. But at least it is some evidence in support of what we may have felt. Second, the fact that metro area districts used A.D.P. more may indicate that they have more access to both information and facilities for data processing. For instance, it is unlikely that IBM will set up a data centre in Fort McMurray or Flin Flon, but they certainly will have them in Winnipeg, Regina, Vancouver, Saskatoon. In addition to this, I asked one more question, "Can you in a couple of sentences tell me why you aren't at the moment using any kind of automated techniques?" And the response to this question from the 44 districts that were non-users were quite interesting. Here are the answers that I got: "District not large enough," "A.D.P. too expensive," "Traditional accounting procedures are satisfactory," "A.D.P. adoption is under investigation" (that means we are looking at it but we are being cautious), "There are no local facilities," "We don't have the space to put the machinery in," and "We are awaiting some district reorganization before we jump in feet first." The number of responses in each of these categories varied, with 20 of the 44 indicating that the district wasn't large enough (these don't represent a total of 44 because some districts mentioned more than one reason), 10 that data processing was too expensive, 8 that traditional procedures were satisfactory and ranging down to 2 each for lack of local facilities, lack of space, and awaiting district reorganization. Of the responses, I think the top two, "district not large enough" and "A.D.P. too expensive" indicate what districts were feeling about A.D.P. and why they weren't prepared at the moment to jump in.

Now, if I might, I would like to indicate briefly what I feel about these two responses in terms of the data that I got. Let's go back to the data as given in Table IV. Now it is true that those who were using A.D.P. were much larger than those that weren't, but in terms of the overall size, the smallest district using A.D.P. had 3800 students. Interestingly, 19 (almost half) of the districts who weren't using A.D.P. were larger than 3800 students. This seems to indicate that size can't be the only thing which is related to whether or not the district is willing to automate some of its operations. Now in terms of "too expensive," look at the difference in costs. Those who were using A.D.P. were spending $489.70 per pupil in operational costs per year. Those that weren't were spending $483.60, $6.10 difference. What does this indicate? Does it indicate that it isn't more expensive to be using automatic data processing? Six dollars more expensive, but that isn't really a lot. Or does it indicate that there are savings when you use A.D.P. that offset some of the extra costs? Well whatever it means, the costs weren't that much different. So it seems to me that for those districts that felt it was too expensive, this wasn't the only reason either.

The only other thing I wanted to mention was that most techniques which have been developed to make education less expensive have not really done so. We were told that if we would get into team teaching we would save money. Well, I don't think our experience there really indicated that it is much cheaper. On the other hand, I think that team teaching can be better for the students. I think the same thing may be true for automatic data processing. Maybe we are looking at it only to save money, whereas we should be thinking more in terms of program improvement such as the way in which access to information about students can help us in our main objective, pupil growth; not whether it costs $6.10 more per pupil per year or not. If one accepts the assumption that A.D.P. techniques will help to make the school system more efficient and effective, then we can draw several implications here. First of all, smaller districts should investigate the possibility of cooperative action. They could get together to standardize some kinds of operations or the use of equipment and services. In a country like Canada where the population is quite thinly spread it would be important to have regional set-ups, because we have few large densely-populated areas. It is going to be very difficult for the smaller rural districts, especially in Western Canada, to get involved in data processing unless there is some kind of coordinated effort.

I suggest that maybe we should be looking to the provincial departments of education to take the leadership role here. First of all, they could help in standardization of both pupil and business accounting operations, maybe by legislation but also by consultative work with the districts. Financial incentives to districts attempting to develop A.D.P. techniques for education could be considered, at least consideration could be given to provincial subsidization of those people who are willing to go out on a limb and develop techniques. Finally, with the technology at its present stage, I think it is possible for a centralized computer to handle most of the districts' operations. If the provincial governments would consider a large computer in the capitals and satellite stations or terminals or consoles for access to this computer, I think it would help a lot in our own development.

Finally, let me say that the potential of data processing is almost infinite. The application to the present problems of education is only limited by our willingness and ability to seek the answers with this most powerful tool.

DEVELOPING DATA PROCESSING IN A SCHOOL DISTRICT

J. Kusnir

In the following report, John Kusnir, coordinator of educational data processing North Vancouver School District, describes the implementation of data processing in his school district.

Having participated in the development from the inception of the idea, Kusnir is able to trace the series of steps leading to its realization. He provides cogent information relating to the planning, organization, and implementation of data processing in his school district. He also spells out the roles of the individuals and groups influencing the innovation. Not only does this provide some guidelines at the operational level for school district planning for data processing, but it also points out problems that can be avoided by careful planning.

-Ed.

This is the story of North Vancouver's adventure into data processing. It is complete with descriptions of the planning, the subsequent problems (some of which have not yet been solved), and the suggestions stemming from the effort to establish a centre for data processing.

Going back as far as 1964, there was a good deal of talk in the Vancouver area about regional centres for data processing. The school boards in the metro area discussed the problem of cooperation in regard to data processing; they went on talking about it for three years and are still talking. In the meantime it has become apparent that we are going to have to get up to date on the problems on technology. The only way that I know of getting anywhere near that blue sky that Dr. Bright told us about this morning is by getting involved. Somehow or other we have got to get mixed up in this business of computers and what they can do.

In the District of North Vancouver, the school board and the superintendent, who are very progressive in their attitudes toward this whole problem, decided they would do something about it. First of all, an administrative committee to investigate the matter was commissioned. This committee conducted a very brief study in which several directors and the Assistant Superintendent participated. The committee produced a report we called "FRED I," the first of three reports. This was the first substantial report in Western Canada that I know of on Educational Data Processing. "FRED" stood for First Report on Educational Data Processing. (A problem I faced when I began writing my own report, which was a result of the one produced by the administrative committee and thus would be the second report, was simply what to call it. When I thought of "second report" words like "SRED" came into mind. That didn't work very well, so I went to the fellow who dreamed up the name and he said, "Oh, I've got this all figured out. There are two or three reports, perhaps four, coming out of this total investigation, some of them being interim reports. Call the first one, First Report on Educational Data Processing, the second and the third, Further Reports on Educational Data Processing, and the last one, Final Report on Educational Data Processing. So we were able to stick with "FRED" and the name has been with us ever since.)

The first report was an informational one. The people involved were prepared to investigate the area, outline what computers were, define some of the computer jargon, and come up with an analysis of the problems involved. They discussed the relevance of computers to education, evaluated the use of computers elsewhere and formed a proposal. The outcome was that those people who examined data processing got committed to it. If you look closely at it, your fears disappear and you realize that this is like motherhood--it is a good idea.

The accounting part of the school district operation, which was just concerned with the financial side, said, "Well, we can't justify data processing, we can't justify the use of a computer, because we are doing an adequate job now, manually. There just isn't enough work to justify it." However, they changed their minds pretty quickly when the superintendent suggested the possibility of accounting by school, where each school would take care of its own budget. Of course, when they realized the enormity of this task they thought that perhaps they could use data processing. However, at first they weren't prepared to justify it.

The first report examined school applications so the committee visited several installations. Their recommendations and suggested guidelines are still valid for anyone going to get involved in this particular job. First of all, look at the needs of the school system. This is what you must place first because the computer must serve the schools, not the reverse. Second, the objectives to be laid out are objectives of total use and total development. If you are going to put a computer in, you must make it do as much for you as you possibly can. It must be used in all departments and it must be used in as many ways as possible. Rather than just isolated applications, try to find all of the possible uses and integrate them into a total operation.

Many ways exist for using data processing in administration. Administrative controls--those kinds of reports, for example, which make a principal more effective at making decisions in his school, those kinds of reports which allow the superintendent to make the same kind of decisions, can come out of data processing. For example, in some of the school districts it is very difficult to know exactly what the qualifications of your schools are. I would suggest that of any two schools, in one school the children get a better deal than in another one because we don't really know much about staff balance. It is too large a job to balance age, experience, qualifications, and so on in one school with those in another. A computer can do this very simply by just comparing the data, once you have your personnel records on file. Another area to be studied is that of operational activities for teachers--doing all the clerical jobs that teachers have to do. Data processing can assume much of this burden.

The report further suggested that we conduct a separate in-depth study, outline a program of development, consider the various alternatives, and thoroughly examine other school systems. My job was a product of this report, I was hired when the report was submitted to the board.

There is one thing that we have to be careful of and that is the problem of simply repeating what was done in the United States during the last ten years. In the first days of computers, it was just a matter of automating manual procedures, such as producing report cards on a machine. This was the first phase. The second phase was a growing realization of what could be done to produce exception reports for principals and superintendents, reports which would underscore operational anomalies, so that administrators need concern themselves only with data about problems. At the present time, call it the third phase, people are looking at much larger systems in an attempt to integrate all the facets. For example, a comparison of cost of programs by prorating the costs of a particular piece of machinery to a program. We may find out for example, that in our vocational courses we are spending $2500 per year to educate each student and in the language arts only $150 per year to educate that student. This kind of information can be retrieved from a good system. Boards may still say this cost difference is necessary and go on without changing the program, but at least they will have the information about what they are doing and the decision will be a conscious one. This is what I mean by integrating the various files, the various aspects.

Coming back to the first report, it stated that this was not an economy measure, that the district was behind the times and that this was a major decision for a board. So in 1967, the board set aside funds to appoint a local administrator to conduct the recommended in-depth study and at this stage they were faced with a problem. It was necessary to decide whether to hire a consulting firm and let them tell us what we should be doing, or choose someone already working in the district, someone who knew the school system, to go out and learn about computers. The board took the latter course, decided to get somebody in education who knew education to go and learn about computers. Of course, they also provided the time and the money to do this.

Another guideline for your consideration, if you are going to get involved, is this. Do not assign the task of learning data processing to administrators or teachers who are presently doing a full-time job. You have to make sure you have somebody who can go into this full-time because it quickly becomes a full-time job. Furthermore, if you are a superintendent and you are going to start interfacing yourself with companies, you will find that three-quarters of your time, time that should be devoted to other things, will disappear. So I, in fact, acted as a go-between between the superintendent and the computer manufacturers. If you are going to get involved, you should have somebody who can do this kind of a job.

So FRED II was commissioned. It was an interim report and, in fact, it proved to be simply a justification of computers. I analyzed the needs of our school system by going to talk to teachers; analyzed other systems, fifteen of them; went through all the literature I could find; and took as many courses as the computer companies would offer, some in programming. You don't have to be a programmer, in my estimation, to fulfill this role, that is you don't have to know how to make computers run. You do have to know what they can do and you have to be aware of what happens in education as a result of what they do.

A problem arose here because teachers just don't know what a computer can do. Therefore it was very difficult for them to identify things a computer could do for them. So there was a problem of telling teachers what computers can do. I went around and talked to people, showed them samples of what other people were doing, got them a little bit involved and then they began telling me what they needed. For example, the teachers said, "What we want is a good testing program where we can diagnose the problems of our children." In other words this is a kind of Computer Monitored Instruction at a much lower level. Instead of having children communicate with the computer, you have diagnostic tests for which the computer will produce test results and give you a complete diagnosis of each child. The counsellors and the elementary principals said, "We want information about students, the kind of information we need to guide them." The secondary school people placed student scheduling at the top of the list because a great deal of time was involved in that task.

In this question of justification a good number of people have said, "Don't try to justify it in terms of cost because you will end up spending more money than you are presently spending anyway. The educational values, the data that you get, will pay for the job." Furthermore, I did pick up some information from various manuals and here are a few facts:

(1) a student has his name written out a thousand times in

the thirteen years of education. At ten seconds per name, this works out for our school district to 500 hours of needless clerical activity. For this we pay teachers somewhere between $5.00 and $10.00 per hour.

(2) When marking a particular test by hand it was necessary to allow 20 seconds per test while by machine it took one second per test. Furthermore, when done by machine you get the mean, standard deviation, item analysis, an error count, diagnosis reports, etc.

(3) Student scheduling takes about three men three weeks, or about 45 man-days of work. At least, this is true the way we produce our student schedules where students are allowed to select various courses and various alternatives. This time investment can be reduced by 75%, leaving 33 man weeks to your administrators or counsellors for doing various other things that need attention.

(4) Attendance, at about three minutes per day, comes out to two extra days of instructional time per teacher per year. If you pay a teacher $20 per day, there is $40 per teacher in your school system.

(5) Report card transcription takes about 40 hours a year per teacher. You can reduce this about 25%, and this is a conservative estimate, giving two more days per teacher for lesson preparation, etc.

(6) In the area of guidance and counselling a study was done which shows you can reduce counsellors' time by 10% by relieving the clerical work load. In other words, the counsellor's time is increased by 10% per month. Which, of course, means for four counsellors about forty extra hours a month for student counselling. I didn't put this kind of information in my report because I attempted to justify it on various other educational grounds which are less subject to argument.

Then we were also faced with the problem of various alternatives. The local municipality had a small computer, and they wanted us to share this with them. Should we participate? Another problem concerned the nature of the equipment, should it be small unit record equipment to start with or should we have a computer which would be capable of having magnetic tape storage? Since a large or sizable data base ranked first in the needs of our system, we decided that unit record equipment and punch cards just couldn't do it; we had to have magnetic tape. The next question dealt with small versus large computer facilities. Just exactly what did we want to do with the computer? And, of course, principals or superintendents or school boards have to decide what is going to happen. In our case, we had to decide what the computer was to do, just handle the district work load, or handle, in addition, the community college which is destined for our area, or should our data centre have a larger computer than necessary for our own needs so that services could be provided to other people, in other words, should we become a sort of service bureau? Still another question was whether to go to the local service bureau for computing services. Dr. Bright pointed out that it costs about $3.00 a student to do all of the jobs he was referring to. I found that to do just report cards and student scheduling at a service bureau would cost us over $3.00 per student, and of course, with a school district of 20,000 pupils you can see what the costs are if you expand the services. So this is one disadvantage of that approach.

In July of 1967, I presented my report, FRED II, to the school board. They told me, "Go out and tell us what it will cost. What is the best alternative to achieve the objectives of our school system?" To do this, I had to establish a basic design showing the things that we wanted to do and what our needs were, because the companies won't tell you whether a computer will do the job unless you tell them what the job is. So you have to define the size of your student files, how many records you are going to print out, the size of each record, and so on for all the various jobs. The preliminary proposals came back from the manufacturers and the costs ranged from $80,000 to $140,000 per year. This included, of course, staff and the computer. I stuck close to Dr. Bright's estimate that personnel costs about 50% of the operation; in fact, I made costs for personnel 60% and those for computer 40%. The thing which limits cost is computer size. The size of the staff depends on how quickly the program will become operational.

The school board at this stage decided that they would like to institute a data centre. However, the municipality began saying at that time, "Well, now we've got to cooperate because in cooperating we can save money." There isn't too much information about the desirability of this, but all I could find indicated that involvement in a cooperative effort in educational data processing is better when only similar operations are involved than when businesses which are different in nature join together.

The next problem was the selection of a hardware manufacturer. Which company is going to give you the best deal, the best computer? Will the computer really do the job? So at this stage we decided to hire a consultant to answer these two questions:

(1) Are we going to save money if we go with the district rather than the municipality?

(2) Which manufacturer should we choose?

At this stage the school board, which had decided that a cooperative venture between educational institutions was the best way to go about the job, decided that they would like to have a computer which could, in fact, become a regional data centre. If the computer could handle 100,000 students, and if the companies were prepared to guarantee the kind of performance expected, we would like to move ahead. In British Columbia, we are forced into this particular position mainly because it will take another year before school boards locally can provide the funds for the research necessary to go into this. It will then take another year for developing, setting up the programming, and accomplishing the analysis necessary to install data processing. Of course, by the time a pilot project is run, which would be another six months to a year, three years will have gone by.

So it was decided that North Vancouver couldn't wait, we'd have to get involved.

Our plans now are to hire personnel and we are in the first stages of doing this. By the spring of 1969 we will pilot test as many of our projects, as many of our developments, as are ready and in September of 1969 we will have a full-blown student accounting system going.

Some of our schools have been participating already, getting the kinds of experience that we need by scheduling their students with a local service bureau. Teachers are getting involved by sending some of their tests to Simon Fraser University to have them machine marked, scored and diagnosed. With the community college coming, we are looking forward to getting that group involved.

Three years from now we hope we can have terminals in the schools, and the students can write programs which will be on call. This is a rather different system from that which Dr. Bright was talking about where any student at any moment can communicate with a computer with a minimum wait of two minutes. This would be a plan under which the students would submit their programs, for example, at 10:30 in the morning, programs would be read into the machine, and at 2 o'clock in the afternoon we would roll the information back out to the terminal to the students.

We are also looking at information retrieval. I have seen small computers, similar to the one we are planning on getting, that are able to retrieve information. The particular case that I saw was one in which teachers had devised certain lessons and lesson plans and the tests that go with them so a teacher could go to a television screen and communicate and get this kind of information from the system. Computer aided instruction is kind of "blue sky" for us yet. However, we are attempting to integrate our financial and educational resources by object/function coding. In other words, if a piece of machinery or something goes into a school it will be charged to a particular program so we will have some estimate of what it costs us to run our various programs in our schools.

Certain problems that you should be aware of are:

(1) Do you get a teacher involved in data processing or do you bring in a consulting firm to tell you what you already know? I would suggest that you get a teacher, give him the time and the money to learn about educational data processing, let him coordinate your activities, and also direct anything that has to go on.

(2) Decisions can only be made when people understand what the problem areas are. This means that you need many conferences like this, attend them all. You must also read widely and get other people and your district involved in these problems. You have got to learn to communicate with the manufacturers, learn to understand the literature. The companies are only too happy to give courses in the larger centres in programming, mainly because they feel if they mention the word IBM or Honeywell or Univac sufficiently often you will buy their machine. Get them involved, they are eager. They have a public relations campaign going on all the time. They are interested in selling, so you can make use of them.

(3) One of the problems that research reveals is that all successful E.D.P. installations have people at the top level, superintendents, assistant superintendents, etc., involved in data processing. They are knowledgeable, they are informed about it, and if the program is to be successful, these are the people who will make it so. Some computer manufacturers give week-long courses if they think you are a prospective customer (and you all are). They offer courses in various places, two or three day courses. Our superintendent went to one in San José. All you have to do is pay your fare. Get informed, get involved in projects like this because this will help make you knowledgeable. Teachers are skeptical about this system. One of their arguments is, "Why don't you spend the money on teacher aides, give us some assistance?" However, you can put in all the teacher aides that you like, but unless the information that is presently generated

in our school system is digested and produced into meaningful reports for superintendents and principals, we will go on living the same kind of existence (as some people call it, "flying by the seat of the pants"), for a long time.

(4) Another point, you must clarify your objectives, decide just exactly what you want to do. In our meeting this morning we were trying to decide what do we do first. Do we use the computer for instructional purposes or do we use it for administrative purposes? The answer, of course, is you want to use it for both. You want to do as many things as you possible can with the computer. What are we going to do in the future? This question, of course, wasn't really answered. I think what we do now has some bearing on the future. A great deal of information and a sense of direction has to be established somehow in what you are doing. Above all, you have got to get your school board committed to go ahead with this and the only way they can commit themselves is with money.

The last thing that I wanted to say was that data processing doesn't cure all the problems in education. It just helps provide you with information which is already there. All it does is put the information together for you in more usable form. Finally, since North Vancouver is hopeful of establishing a data centre, we would be only too happy to have anybody join us in planning this development and also sharing in some of the benefits which are going to result.

DATA PROCESSING AND PROBLEM SOLVING IN EDUCATIONAL ADMINISTRATION

Dr. Frank Farner
President
Federal City College, Washington, D. C.

One of the basic aims of the conference was to consider whether or not data processing had reached a level of development at which it could function as a useful administrative tool. Thus one objective was to discuss possible uses of data processing approaches to various kinds of educational problems. Frank Farner not only discussed examples of data processing usage to reduce manual labor in education but also illustrated applications which would enable an administrator to ask administrative research questions of an "If - then" nature, and answer them with data from his own district. Farner's presentation should be of considerable value to the administrator interested in examing some details of his school system's operation.

-Ed.

I am particularly pleased to be able to address this conference because of the long-term close association between the University of Alberta and the University of Oregon. While at Oregon I enjoyed the opportunity to become acquainted with a number of people from Western Canada, thus the chance to meet with some of them here and renew acquaintance is appreciated.

I am also particularly pleased to meet with a group of experienced superintendents and board members, many of whom, I am sure, feel some concern about the rapidly developing field of data processing. I would like to dispel some of that concern this morning; talk a little bit about the strategy of the implementation of data processing in school systems; show you in visual form some three or four of about twelve applications (for school districts of approximately the size represented in this room); which we tried in a very modest way at the University of Oregon, and then try to field any questions you may have.

First of all, I want to say that I agree very much with Dr. Bright. While I didn't hear his total presentation I went over some notes with him last night, and we shared thoughts about it. In connection with this, I wish to make two major points. First, in the work that we were doing in Oregon, there were perhaps as many as five distinct applications, instead of the four which Dr. Bright mentioned. He discussed the student file system, a finance file system, a personnel file system, and an inventory of physical property. I think there is yet another area which is very intriguing and which is very often harder to develop, yet, I think in the long run it may be the most valuable of all. It is something called the curriculum file, which contains such data as the content taught, by whom, in what courses, and in what years. I feel this is a fascinating area in which to attempt cost benefit studies from the finance side, and teacher effectiveness studies from the instructional side, so that I would want to encourage you to conceive of a five-file system rather than four.

Now for the second point, I heard John Kusnir yesterday afternoon set off the dilemma that school districts face--whether to have outside consultants tell them what to do, or provide training in data processing to an inside person. I think there is no question, but that if you have only one possibility open to you, you should do the latter, as he said. In the long run, however, I think almost all school districts find that it is appropriate to use both methods. In the first place, you have to be very careful about the inside person selected for training. If the inside person is someone who is suspect by the faculty from the beginning, he cannot go off and take this training, come back and be one of the gang, and still be the same old fellow that the teachers and the principals will respect. Even after he has acquired this new information, he would not then be very useful to you. I have seen this happen in a couple of situations in Oregon, where fellows who were obviously data processing types from the beginning took a little more training and came back, but they were still not someone whom the teachers would accept.

I also want to say a strong "amen" to the matter of the superintendents and the business managers, and the pupil personnel directors, (or directors of research or guidance, or whoever handles test scores, especially), being trained and involved in this field. The training of people in data processing as part of the regular academic program has a great deal of merit. In the last four or five years, at the University of Oregon, practically every doctoral graduate who finished has been at least partially "hooked" on data processing. The use of computers in dissertation research has gone up greatly. This is also true nationally. I think that this generation of men as either professors of educational administration, or as practising superintendents, will have a "feel" for the situation.

I find that in my present job I'm having a very difficult time getting academic vice-presidents and main-line faculty to take an interest in data processing, even though I take a very strong interest in it myself, so I am simply going to end up imposing it. An IBM man with whom I was recently talking said that he could count on his hands the number of college administrators that he had met that were really interested in it in the first place and, in the second place, the least bit knowledgeable about the field. A generation from now I think that will change, and that's very important because without the interest of the superintendent, and even some of the board members, these programs have very rough sledding.

In some ways, the discussion of the use of convincing arguments to talk about why data processing is necessary may be "tilting at windmills" because the mass of information that the students are studying (and this gets into information retrieval) added to the mass of information that we are generating about students and about our educational program, is getting to be of such magnitude, that the storage of it and the retrieval of it in some kind of mechanized system, is simply mandatory. I also think it is going to be such a commonly accepted part of the educational facility, that we simply have it as a matter of course, the way we have overhead projectors and chalkboards, and the way we have added all kinds of aids to the classroom. The matter of questioning whether the cost-benefit ratio is favorable, or questioning whether the time usage is justified, et cetera -- the questions in so many peoples' minds now--those questions will simply not be asked. These will be things that are taken for granted. In the long run, somewhere along the line, something like this is going to happen, then the whole thing will spread throughout our entire society. Such use is already going on all the time with gasoline credit cards, bills from many sources, and the processing of dividend cheques, and so on. This is taken from the same kind of mold, and so the whole thing is just going to be taken for granted as part of society, in a way that isn't really quite true yet.

I often think that perhaps even the cost factor will eventually be damned, that this won't even be considered--it is something you'll have and you won't question the cost of it. I think this can be a dangerous thing, however, as well as almost inevitable. Now, the key point I would like to make is that, in my view, it seems to be virtually inevitable that data processing is coming, both because of need, and because of the whole nature of the use of data in society. This doesn't mean that we will totally tap its full potential. I think there is a tremendous difference between those school districts that are simply using data processing for a mundane business office, or pupil accounting operation, as compared with the very sophisticated uses being made by others. The difference now between districts that don't have anything and those that have a little may be expanded within a generation to districts that have a little data processing versus districts that have a lot. There will still be wide ranges among districts in data processing use, even then.

The matter of cooperative ventures among school districts is a necessary part of the whole picture. I say among because in my opinion two is almost never the limit of participation, there should be at least three districts. Grouping of districts is virtually essential, because, except for Los Angeles or New York or similar large systems, there are very few single school systems large enough to really tap the capacity of an optimum size computer without any time or services available to neighboring school districts. That is one reason why cooperative ventures are inevitable. Second, even though in the United States we have reduced the number of school districts from 140,000 to 28,000 since 1932, that 28,000 is still about 20,000 too many, so that many of the school districts are relatively small and their needs are going to go way beyond what they themselves can command. Also, it is a tremendous waste of time for everybody to be doing the same thing over and over again all the time. John Kusnir yesterday made an excellent point of this. Cooperative ventures, then, are nearly inevitable.

I also don't think that there is any major objection to cooperating with non-school organizations, as long as a certain amount of autonomy or sovereignty regarding the design of the system and the use of the equipment can be retained for the school district. I think that so far we have had less than the optimum amount of co-operation, at least in the United States, between the school systems and the municipalities in such areas as building permits, bus routes, assessment practices, overlapping taxes, and so on. I can see this data processing business as possibly being a way to bridge the gap between these government agencies. We must work at it to achieve cooperation. I have seen county governments in California give good service on school district payrolls and school district attendance accounting, through a county data processing system, so I wouldn't rule out the possibility of achieving this. Of course, when you are in a quasi-dependent school system arrangement, as I understand you are here in Western Canada, where there is some possibility of the municipal government affecting the passage of your budget, it would be poor policy not to encourage these people's good will.

The United States Office of Education three years ago funded a program called OTIS. OTIS stands for the Oregon Total Information System, which I always thought was a rather grandiose title. That "total information" sounds ominous indeed, but it is an effort to develop the five files I described in my opening remarks, and make them available to all the school districts in Oregon. At the present time, the cost of OTIS is borne out of a grant, but school districts are signing up as participating members. As I understand it, some sixty-five school districts, which includes virtually all the larger districts except Portland, have now agreed to participate. Portland has enough size so that it is already in data processing. Since this district is already in the field to a greater extent than the other districts, it is difficult for it to change and join the OTIS program. The sixty-five districts are fully cognizant of the fact that as each year goes by the percentage of the total cost to be borne by the district goes up, and the percentage borne by funds other than the district will eventually be zero. This will be a testimony, then, to the success of the program.

One of the key events in this success, I think, was a conference held about a year ago, in a setting very much like this setting, (or Oregon's best approximation of this kind of scenery) of superintendents of the major districts. A room about this size was filled with computers. The superintendents were brought there, very much as novices in this field, and they began actually writing computer programs. I was impressed to note when I got there near the end of the program, that the day began early, about seven or eight o'clock in the morning, and went until only about two. Then everybody played golf, but they were expected to come back and program and work on the machines in the evening. Many of the superintendents I'd fine there at 10:30 at night and working on until 1:30 in the morning. That is how much interest they were showing in this. As a result of this, literally dozens of school districts that had been cautious before, became very interested. Thus, I think if this conference this year was really a kick-off to whet your appetite, I wouldn't settle for anything less than a "hands on the computer" kind of experience next time around because it's an experience for you that will make this whole thing much more meaningful. It isn't the appropriate first conference but it is the appropriate second or third.

I would now like to turn for a moment to some overhead transparencies and some examples of services which we attempted to provide to moderate-sized school districts in Oregon. First, let me tell you the circumstances under which we did this work. We had an agency called the Oregon School Study Council, which has a lot of school districts in Oregon as members. They were districts that had no capability to use computers, simply because they had no staff in the school district familiar with computers and they had no access to computers. They did find, as they went along, that many of them had more access than they thought, that there are more computers in factories and businesses in smaller towns than you would imagine.

As we dealt with these districts, we said to ourselves, "What are some services that every school district needs, but few can afford to do, which a computer does better than manually?" So I am going to show you three examples and then discuss more briefly four or five in addition.

The first one is an effort to calculate the load of secondary teachers. Some of you are familiar with the Douglass teacher load formula. (It is possible to make up your own formula, if you can agree on the components). Certain types of input data are required in this program. (I'm spending a little bit of extra time on this topic because I think that the concerns about input are heavy in the minds of school administrators.) How hard do you have to work to generate the information that is required to put into the machine? This program requires that each teacher in the school system have some kind of a unique number, which becomes data in the system along with his name, if you like, but that isn't necessary; information about his first class--it could be period 1 or period A--it doesn't matter as long as all the classes are listed; the number of minutes in the class; the number of the course; the grade level; and the number of students, is also placed in the system. Then that same information is coded for each period, and that's all that is required. Normally a copy of a secondary school schedule with the class enrolment written in on the schedule gives you all the information that is required. In other words, the information is usually readily available.

The next thing needed is a subject/grade level coefficient table. This can really get controversial. Some of you who have worked with the Douglass formula know that he says that some subjects are more demanding to teach than others and he gives them different coefficients. In the Douglass table, art always gets a coefficient of .85. Metal working 2 gets .80 and metal working 1 gets 1.0 for some reason. Biology gets 1.3. Therefore, you need to generate the Douglass table. These are all the data that are required. As a matter of fact, if the administrator thinks that a subject is the same at all grade levels, then only one coefficient is needed beside each subject.

The first task in using the data is simply a tally of the information. For example, the slide shows that Ackerman, the first person listed, taught six courses; three of these were different courses, and he had a total number of 129 students that he taught for 300 minutes. Next, there is a calculation according to the Douglass coefficient. Or, if the particular school district wishes to use a set of coefficients which is different from the Douglass coefficients that set is calculated. Another calculation can be done in which all the coefficients are set as equal to one, so that the effect of the coefficients is wiped out. We later developed the ability to reverse all these coefficient tables, just so we could take all the "starch" out of any faculty member or anyone who tried to argue about it. So if the coefficient for art is .85 on the Douglass formula, the Douglass reverse makes that 1.15, or the same amount above 1.0 that it is below on the regular formula. Each set of coefficients produces another set of data. After this, the teacher load under each formula is calculated. In this case, there would have been five calculations, the constant plus two formulas and their reversals. Many times the reversal of the coefficient doesn't change the load a lot because the person simply has a heavy burden of students or a large number of periods taught.

A word may be necessary about stategy in the use of this material; we found it better to release only the results of formulas that people had agreed on, so that we didn't have a lot of argument about coefficient tables; but for experimental purposes, other coefficients are quite interesting.

In order to develop this further and show what can be done with this data, we also put together some statistical analyses of the loads in a large school district which had 185 secondary school teachers (high school teachers only, not junior high). There were 107 in one school and 78 in the other. The mean load (based on the user-developed coefficients) of everybody was some mystical number like 27.6. They differed 27.1 and 28.2 from school to school, not a very significant difference. By sex, it was a very chivalrous school district. The men were carrying much heavier loads than the women, 28.7 versus 25.9, which is a statistically significant difference. By departments, they ranged from 31.7 in physical education down to 21.4 in the language arts. That was greatly affected by the weighting, because if you use the Douglass coefficients which give physical education a low weighting, they don't lead the pack in work load. However, this user group felt that physical education deserved a fairly high coefficient. Other inter-departmental comparisons can be made just as easily.

One of the best uses of this kind of program is in an effort to find the teachers who have either very high loads or very low loads, and then say, "Can this be explained?" Is this someone who is carrying an especially heavy burden in counselling or perhaps a person who is especially old and for whom a low load is desirable? The most effective use may be not the statistical analysis but the individual consideration of each person's case which becomes possible. A principal with teachers who are in trouble can look at their loads and see if they are carrying especially heavy loads. Perhaps they should have lightened loads in order to find themselves, especially beginning teachers.

This is an example, then, of a service that some kind of regional or multi-district operation could provide for districts. The cost of operation is virtually nil. This was run on an IBM 1620 card-in, card-out type, a machine that is of no cost at all. It requires something in the order of ten minutes to do this whole analysis. We repeated this program for the same district, three years after the example I have illustrated. We did it on an IBM 360 Model 50 and did it in about 40 seconds. But the cost was actually greater, even if it did take ten minutes on the old machine.

The next example I want to show you is a Schedule Conflict Matrix, which I know was discussed a little bit yesterday, also. It is possible to go to Stanford or Purdue or elsewhere and have a very elaborate secondary school scheduling service performed. However, most districts of say, 500 to 1500 enrolment in high school are not, unless they have a sharp young fellow who wants to get into this, really quite ready for that. This program stops at a point short of the more intricate ones.

Two major inputs are required;

(1) A list of courses to be offered with a number for each of them specifying first, the minimum size for which the course will be offered (which can be set at 1 if you like so that this will take care of the matter of whether you ever cut off due to low enrolments) and second, the maximum number of students which will ever be in a single section of that course, and then

(2) The course preference list for the students. Student numbers are not absolutely essential, even student name is not necessary, but it is kind of useless to punch a card with the student's course preferences and not identify the card at all. In this particular program, student I.D. isn't used but the same card might be used in others. Student sex and grade and the courses that he would like to take, up to seven courses, are on the card. It is possible to even get into the matter of second choices and so on, some programs do.

This program, while extremely modest, still has proven very useful to as many as twenty districts in Oregon. This is also an IBM 1620 program which will operate on very, very modest machines. The results give the same list of courses, repeat the maximum and minimum, show tallies of the number of student requests for each course, list the number of sections and provide an average section size. In this example, courses are run against each other, and as shown on the screen, there was only one conflict out of the total, there was only one student who wanted both Arts and Crafts and Girls Glee. You've all been through this process. Searching through the print-out list for the maximum-sized conflicts identifies the courses to schedule at different periods to avoid conflicts. There still remains the matter of loading all the students in, building the schedule to get the minimum number of conflicts, and the problem of the teacher of a subject not wanting to teach it at a time that makes the least conflict. With this program, however, that cross-tally that otherwise must be done by hand is done for you. This is a very modest attempt to take over in an automated way something that is done manually. It also produces the kind of table on each course (these are one-section courses) which reveals conflicts between one-section courses and other one-section courses which is, of course, an important factor. Conflicts with two-section courses or multiple section courses are also identified.

The next step, of course, would be to find out the names of students that are involved in the conflicts and then prepare a schedule in which they are best accommodated in the number of daily periods. Suppose you have a choice between students having a conflict on a subject that isn't required at a certain grade level. It might be better to let that remain a conflict on the grounds that they can take it the next year. On the other hand, classes which must be taken at a certain time in the student's career are more important conflicts. Obviously, there are all kinds of side issues here. The point that I am belaboring is that this program is a very simple operation.

The next area I want to examine is enrolment projecting. This one has the simplest input of them all. All you need is a graded enrolment chart, a historical chart, with the years across one side and the grades across the other. It shows by grade the number of students in school each year for some number of previous school years. That is the only input.

Now, the output. Almost any kind of output is possible with this program. In fact, it can give you any answer that you like. The first thing the program does is compute the survival ratio. This is a survival ratio technique enrolment projection where you are comparing the enrolment in grade two, for example, with the enrolment in grade one the year before. This is done for each grade level and each year of progression from grade to grade. In other words, a total matrix is calculated. The average grade ratios are then displayed. Three ratios are calculated, the high, the mean and the low. It is even possible at this point to introduce ratios, for example, provincial averages, or the ratio of the most recent school year. This is useful since it allows modification for special conditions. If it is known, for example, that the local parochial school has decided to discontinue enrolment in grades one and two and start only at the third grade or something like that, this means that there should be a major difference in the input data and a different ratio should be introduced. The output is in the form of a table showing the years, the historical data which formed the base, and then the projections for the future.

Initial grade data should be explained. Eventually, you have no first grade information to project for the future. I call the first grade the initial grade although it could be kindergarten or it could be seventh grade or ninth grade if you were doing a projection for a high school district only. It could even be thirteenth grade if you were doing a junior college projection. This program extends the first grade enrolment upon an arithmetic basis, increasing by the same amount each year. The extension is on the basis of the increases experienced in the first grade in the past ten years, an average arithmetic increase. There is a possible variation, the program will permit this to be done geometrically, that is, if first grade enrolments have been rising at the rate of 3% a year, the projection will rise by 3% a year. It is also possible to provide for no increase in the first grade or for the superintendent to introduce what he thinks is going to be the first grade enrolment. Another method gets into the history of local birth rates. At any rate, if the district provides the initial grade data the projection can be made for the mean, the high, the low and the introduced survival ratios. With four variables on each side, the print-out supplies 16 of these tables. That is why I said you can get any answer you want. You can paper the walls with output. This becomes one of the problems in administrative use of data processing, because you can really get so much output you can't understand what it all means. It is important that you end up with a manageable amount of information.

The next example is especially useful for a superintendent. It deals with the question of teacher salary costs for next year versus the current year or a comparison of teacher salary costs in West Vancouver with North Vancouver, et cetera. This program will handle either one of these questions.

There are three major factors that change the teacher salary cost from one year to the next in a school district. The first of these is the salary schedule itself, how much is paid to a teacher at each cell of the schedule. The second is the location of the teachers on the schedule, the cells in which they are distributed. The last is the number of teachers, which can change as a result of enrolment growth causing an increase in the absolute number of teachers.

For illustration, let's consider that this school district has the same number of teachers from one year to the next. This program will then accept two salary schedules, Schedule A and Schedule B. The total calculation takes only a minute, so if you are uncertain about next year's schedule, you can put in Schedule C and Schedule D and Schedule E, all against this year's schedule, to see the relative effect on cost of alternate schedules. You can take the Teachers' Association Plan and put it up there as it is. You can take the School Board's, the Chamber of Commerce and all other parameters. The other two inputs are the Distribution A and the Distribution B. The Distribution A is the location of your 100 teachers on the cells this year. Now you may know that out of 100 teachers three of them are going to retire and you know where they are on the schedule. You then make an estimate of where their replacements will be. For Distribution B, everybody is moved down one row with the idea that he is going to have another year of experience, except those people who are already at the bottom (which represents the top of the schedule). With only 100 teachers it is possible to make estimates about people who are going to move to the right on the schedule by obtaining more training. Thus, it isn't an impossible task to take the hundred teachers and redistribute them on an estimated basis for a subsequent year on the basis of replacements for retirements and resignations as well as account for the movement on the schedule of the continuing teachers.

This program will also handle growth of the staff, but the output doesn't provide as much in the way of research if additional teachers are included. The program calculates the total cost of all four combinations:

(1) The current distribution on the current schedule,
(2) The current distribution on next year's schedule,
(3) Next year's distribution on the current schedule,
(4) Next year's distribution on next year's schedule.

Or it can be used to compare, for example, North Vancouver with West Vancouver. The input data for this program are, of course, very, very simple. All that is necessary is a salary schedule. It is designed to work with an index schedule or a dollar amount schedule, whichever is the style used in the district.

I want to conclude by describing some other things that can be done. Another kind of service that can be provided is a recalculation, upon a state-wide basis, of the amount of state aid required under any possible district reorganization plan that anybody proposes, as long as existing districts are used. The status quo can be the basis, or various plans to unify and reorganize on many different bases can be the focus. It is possible to take all the high school districts and put them together, all the elementaries, counties, regions, etc., and unify them, or whatever else is desired, and determine the total effect on the state apportionment. Of course, the fewer districts there are, the less equalization is required.

Another program might be of interest to those concerned with efforts to increase the amount of provincial support or change the plans by which money is distributed. It is possible to set up a small computer program which will calculate overnight any plan that anyone can propose for governmental financial support. The printout provides information concerning total cost as well as the effect (increase or decrease) upon the funds received by each district. This program illustrates that it is not necessary to operate in a vacuum all the time. Information as to the effects of proposed legislation is sometimes of great value.

One last example deals with a study of "who takes what." This was a college-level study but it would apply at the high school level as well. The study was concerned with the courses taken by English majors in college. One comparison was the percentage of their course work in English with the percentage of course work in each other field. How well do they do? Do English majors get better grades in English than other majors? Is there any group that gets worse grades in its major than people in other majors get in that same subject? These are examples of the questions that can be asked and answered.

I have pointed out or briefly described a succession of eight applications of data processing and research in education. All of these are well within the capability of the most modest district and, in cooperative arrangements especially, may be accomplished at relatively low cost. My main mission this morning is that I want very much to dispel the concern that data or information processing has to be a major money consumer and a major time consumer, or that a lot of additional personnel are required.

All of these activities have been described in a book by John W. Loughary, and others called Man Machine Systems in Education, published by Harper & Row about a year and a quarter ago. The applications in Educational Administration, the three that I put on the overlays, and some of the proportionate analyses, are described in great detail in that publication, along with many applications in student personnel services. Many uses are possible, it simply remains for districts to select those they wish to employ.

VIEWPOINTS ON EDUCATIONAL DATA PROCESSING

PANEL

Chairman: Dr. F. J. Gathercole

One of the objectives of the conference was to examine the possibilities and implications of data processing from a number of vantage points. A panel of educators provided different points of view of various aspects of the implementation and use of data processing.

From the beginning of the conference planning it had become apparent that the smaller school districts would hardly be able to cope with the many problems involved in computer use by themselves. They must then look elsewhere, perhaps to larger administrative units, not only for information but also for assistance and cooperation. For this reason the conference concluded with an analysis of points of view from the provincial level and from the central office and school building levels. The panel members were drawn from a provincial department of education, a school district central office and from two school buildings in different provinces. The impact and import of data processing for people in like positions were noted. The introduction of the computer called for participatory action on the part of all four mentioned.

The panel discussion, which was ably chaired by Dr. F. J. Gathercole, follows.

-Ed.

Provincial point of view

Dr. John Reid,
Coordinator of Research,
Alberta Department of Education.

From one point of view, education itself is an information gathering and processing system. The interaction between students, teachers and administrators consumes enormous quantities of data and also produces a great volume of information with the participants spending a large portion of their time in collecting, storing and retrieving that information. The Department of Education and provincial school systems have also used the collected information in making decisions upon a variety of questions. The information required for these purposes bears upon such areas as the instructional program, the facilities, the pupils, pupil services, personnel and also finance or business affairs. This information has been collected yearly and used as a base for major decisions in curriculum, in business, or in research. The information has also been used in establishing financial policies and producing forecasts. This information, then, has been used for administrative decisions.

As the school systems in the province have become larger the decisions have become more complex and the information required as a basis for these decisions is therefore much more expensive. When this became apparent, Dr. Byrne, at that time our chief superintendent, but now our deputy minister, was convinced that an improved system should be established for our own province. Consequently, he called together a number of people from the Provincial Data Centre, the university, school boards and the Department of Education. This board has become an advisory board and has met a few times to try to develop long-range goals for information retrieval systems.

The Department has also conducted a feasibility study (really a misnomer because we know that using computer technology within the educational system is feasible). After this was finished, a new branch of our department was formed and called the Operations Research Branch. This branch has two main functions, that of research and that of the collection, storage and retrieval of data. I would like to discuss very briefly, then, what an information retrieval system might look like.

If we collected all of the information on the various components within a school system upon which to base decisions we would have something like four or five files of data concerned with such aspects of the operation as pupils, personnel facilities, transportation, finance, programming and so on. Now, if in these filing cabinets we had all of the information relating pupils to personnel, pupils to facilities, pupils to transportation and finance, and pupils to programming, then we would have an information system relative to the pupil component. Similarly for personnel, similarly for facilities and for the other components. However, in each filing case we would have considerable duplication of information. Thus, while this would actually be a total information system it would occupy a great deal of space and constitute a tremendous problem in trying to maintain it. Reduction of bulk, then, is one good reason for using electronic equipment.

We can consider these components of data and can view them as files. To me, each file and its contents must consist of the information about a specific area but must also be compatible with all other files in the system. There may be some information within a particular file, within a student's file, for example, that is specific only to that file and does not necessarily relate to any other file. However, the information related to and from other files must form a complete system of interrelations and, in some cases, even within files there will be intersystems. I feel that there is a common core of information running down the file--especially in the pupil and teacher files--which is particularly applicable to the provinces, both among provinces and for each province. There are also specific things that the departments within the province now require which would not be required if we were thinking of a total information system on an interprovincial basis. There would also be, I think, information which school boards would require that would not be in the other two files.

Instead of only five files, I have conceived this provincial system to be a little bit broader in scope. Although there are five main files, as many as five more might provide methods of interrelating the files.

The five main files are the pupil; the personnel; the program; the finance; and the facilities files. I will agree with other speakers who have spoken of the program file as being a separate file because it is with this file that you interrelate students and teachers. To me there is also an organizational file. This is merely the numbering systems of the schools, the school units within a province. Then there is a transportation file--which I think of as being separate from the facilities file because of our various types of mobile equipment. To me there is another file for the levels of instruction and a functions file, the functions played by particular people in the school system as well as the positions that they occupy. Finally, there is the economic classification, which is a sub-file to that of finance. All of these files are related.

The interrelationships among the various files might be viewed as a general reference matrix, which shows the interrelationships between various classifications. Within each area subdivisions can be identified, for example, instruction may be broken down into a number of classifications including pupil services, guidance and counselling, psychological services, library, audio-visual provisions, examinations, pupil residences transportation, etc.

Development of this system is not something that is going to occur overnight; this may take seven or eight years. Even so, I feel that there should be an overall plan whenever one starts into this and we are hoping that we can develop one. Finally, I think that all units must develop some sort of a critical path. The one that we are attempting to follow now is a four-year program, although we are now a little bit behind schedule.

In closing, I think that I would like to say very briefly that an educational information system encompasses administrative and management information as well as instructional information. These two systems not only overlap but are completely interrelated, a change in one necessarily has a great impact on the other. Therefore, for a total information plan to be really adequate it should as a minimum meet the following criteria:

(1) The data should be collected only once, after which it is necessary to work on, and up-date the system.

(2) The integration of the files will link student with teacher, course, and facilities.

(3) Rapid access to the information will provide timely data for reports.

(4) The system must be logical, proceeding from the objectives to the means of accomplishment.

(5) The system must be flexible and action oriented.

(6) The system must be completely documented.

We in the Department of Education are working toward establishing this system and hope to work with school boards throughout the province in its establishment. We feel its implementation will constitute a tremendous educational advance.

Central Office point of view

Dr. Len Sampson,
Director of Education,
W. Vancouver.

It seems to me that, as a result of this conference, some may well be asking what are some of the things we can do and what are some of the things that we might reasonably be trying to do? Dr. Bright, in his excellent presentation, indicated a number of applications that are out of our reach right now, but he did make mention of things that are within reach. So I am interested in looking at how do we get started and what can we do right now?

I am giving you a school district point of view and I represent a small school district--I think it is important to realize this. Our total student population is only 8,600 or 8,700 and our total secondary school population is only 3,400, so we are not a big system. When we looked at the major applications of a computer in education we dismissed them as being impractical for us. Then we asked ourselves the question, "What should we be doing?" and more specifically, "What can we do?" As a result of this we have come up with what I would call a "two-pronged" approach to the use of the computer in education. We didn't have to be convinced about the value of using the computer for administrative means or for providing the types of service that we have heard about during the two days here. Even so, we are not doing anything in our central office on the administration-accounting side, payroll or anything like that. I think we should be but we have yet to convince the secretary-treasurer of the value of this.

Starting in 1964 our people at the secondary school level, in particular our principals--they were the ones who provided the real leadership here and the real impetus--recognized the merit in being able to process all sorts of information on students and so since then one of our secondary schools has been looking at this. During the years since then they have come a long way, refined the work they have done, modified it, improved upon it, so that in the 1966-67 year we embarked on a contract with an educational data processing centre in California, one of the regional E.D.P. centres.

We contracted a service arrangement with these people and received what I would call a "pupil personnel package" that deals with a number of the things that John Kusnir mentioned earlier as envisaged for North Vancouver. Since our principals were satisfied with what they were getting after we had experimented for a year with the centre in California, we expanded the service to include our other secondary schools. We are continuing to refine it, to modify it, so that we obtain in this package deal a lot of information about our students; the lead-off information for the scheduling of students, testing information three or four times a year on standardized tests, and also report card information. In summary then, this first approach was used because we wanted some service.

Since we are a small district, we could not afford to install anything. We could certainly not afford to buy any equipment, any hardware. Therefore, we wrote out the details of the type of service we wanted, defined in educational terms what we wanted, and this centre came back with a package that at the moment suits our needs.

You may be interested to know that it is costing us three dollars a student for this package deal. Since we have about 3,400 secondary students you can work out the total cost, and I might say that we look with great interest upon the possibility of the establishment of a regional data centre in the greater Vancouver area. We look with interest at what our friends in North Vancouver are doing because we are not doctrinaire about buying service from California. We bought service from California because this centre was the only one that could give us the service we wanted. When anybody else can come along and give us an equivalent service we will be happy with it. For this reason we are pleased with what we see going on in North Vancouver School District.

The other approach, and one that to me is far more promising and, as Director of Instruction, the type of thing that I would become very excited about, is something that both Dr. Bright yesterday and Dr. Farner this morning touched on. It is also something that Mr. Robinson, trustee from Trail, asked about. It seems to me that some of the things we teach at the secondary school level today have little relevance. I think we have to examine this question but there is no doubt in my mind about the relevance of the computer and about technology. Therefore, I made the following points when I presented a report to the board in the early spring of '67.

I really believe that we need to give our secondary students an understanding of the rapidly expanding technology which is impinging upon us all. The full potential of this new technology has yet to be understood by many of us. We know it is having quite an impact on business and science, but few of us in education really understand what computer science is all about. You might be interested to know that we surveyed all the teaching staff in our small district and 94% replied that they knew little or nothing about computers.

I went on to say (in my report to the board) that I believe that courses in the principles of computer operation should be offered to secondary school students. A fair proportion of our secondary students can learn to use the computer and can learn some standard computer languages and techniques that for many of them might be most useful in post-secondary education or employment. There is little doubt that there is a great lack of skilled manpower to staff the ever-growing number of computer installations. A quick glance at the help-wanted section of any daily newspaper provides ample evidence of the critical shortage that already exists in Canada. The situation has produced a bonanza for dozens of commercial schools which have moved into the training gap and many of them have rather dubious qualifications. It would seem to me that as educators we should be taking some action to ensure a steady flow of graduates with at least some orientation to the principles of E.D.P. I have been to a number of conferences and seminars in recent years where educators have gathered and debated the need for systems and data processing courses in their secondary school programs, but to date not much has really taken place.

Finally, in my presentation to the board I also said that I believed it to be essential to introduce and expose our teachers to the computer and its possibilities. I believe that we must take steps immediately to prepare teachers for a new role. They must understand not only the impact of the thinking revolution generally but the immediate effect that this must have on their specific subjects. Teachers need to be introduced and exposed to the teaching strategies available. In this way, we will have a pool of teachers who have been exposed to computer operation and will be prepared for whatever developments might become available in the near future. As a part of our presentation to our board, we noted that we had on staff a teacher, a first-class teacher, extremely knowledgeable in computer technology and with a very keen interest.. There was an opportunity here because we had a fellow right on staff who could take hold of this thing, give it the direction it needed and give it the leadership that it required. We felt we should capitalize on having somebody like this on our staff.

In quick summary, here is what we did. In 1966-67 we spent a year undertaking a sort of a feasibility study of how we could use the computer in the classroom and we developed four aspects of this. We developed

(1) The rationale for getting the computer into the classroom,

(2) An overview of the uses of the computer in the classroom when we got it there,

(3) The objectives we would like to come up with as a result of having a computer in the classroom,

(4) An estimate of costs involved.
We also sent the teacher who was already knowledgeable to the United States to participate in a course that dealt with using the computer in the classroom.

In the summer of 1967 we installed a computer in one of our secondary school classrooms and when school started last September we had the centre established. We are now giving every student in Grades 8, 9, and 10 an exposure to the computer. One of the five periods in mathematics in their cycle each week they spend in the computer centre getting the "hands on" experience with the computer that we heard about this morning. They are being introduced to preliminary flow charting, writing unsophisticated programs, and they are introduced to computer language. They are told and shown what the computer can do and what it can't do.

Shortly after we had this computer installed, the same company gave us on loan another small computer that we are using primarily for our business education and commerce students. All students who are taking commercial courses and business education are using this, so that we are using the computer as an aid to instruction and are also using the computer to expose all the youngsters in the school, as far as this is possible, to the computer. If I sound sort of enthusiastic at this point it is only because I really am enthusiastic. We have some interesting results. The students are extremely keen and it is very interesting to see students at the Grade 8 and 9 level doing some work using the computer. We now have in this school a computer centre of three rooms. The teacher that I mentioned is the director of the computer centre and he gives the entire program this sort of direction.

The other aspect, of course, was that we wanted to expose all our teachers, as far as this is possible, to the computer. During the course of this year we have been putting them through a series of orientation courses. Some attended just five sessions of two hours each, while those who were interested and wanted to go further could take an additional five-session series or an additional ten-session series.

This is, I think, all I need to say at the moment. I would just, at this point, like to give the entire credit for the success of this aspect to the teacher responsible, Mr. Bill Goddard. He is the gentleman who really gave the whole thing the essential leadership and the direction that it needed. Because he was so knowledgeable in the field himself, he taught those of us in central office. Certainly all that I know about the computer and the technology I learned from him. I will close by noting an unanticipated benefit. The additional computer in the school is now also being used for all sorts of administrative purposes, the running off of stencils and things. And this, too, is a very interesting sort of concomitant return as a result of getting into this program.

Point of view of the high school principal

Mr. Allan Stables, Supervising Principal,
Delbrook Secondary School,
North Vancouver, B. C.

Perhaps I could start best by describing one of the things that goes on as a result of getting involved in data processing. I knew as early as September, 1967 that the following year I would be involved in data processing both for scheduling and evaluation and I was concerned at that time whether I would be able to make some sort of comparison as to what happened in the classroom before we were involved with computers and what happened afterwards. As an illustration, I will use two questions on a questionnaire which I gave out on October 15, 1967 to which teachers replied. The same questionnaire was used in October, 1968 after we had been involved in data processing. So the teachers had been in the classrooms about six weeks in each of the years.

The first question for individual teachers was: For how many of your students have you found it necessary to make adjustments in the teaching-learning situation because of their physical handicaps? In October 1967, the reply I got indicated that seven pupils had been located out of 850--only seven and some of those were noted by several teachers. On October 15, 1968 when data processing had been in effect for scheduling and the print-outs had been sent to teachers, giving health status of students, achievement, D.A.T. scores, etc., the same question resulted in 67 positive responses out of the 850 students. What I judge from this is, when they had the information on the health status of students they made some adjustment in seating arrangements and so on.

The second question was framed as follows: How many different instructional groups have you found it necessary to institute within your individual classes because of variation of ability and achievement levels of students resulting from inadequate scheduling?

My feeling was, in October, 1967, that I would get lots of these because teachers like to have a poke at you when they look at your schedule. Out of the 240 classes in the school there were 13 individual or small groups to provide for some individual differences. The next year we were able to plug in all sorts of homogeneous grouping and do all sorts of work with individuals, even make up special classes with the use of the computer. At the same time, we were able to give the teacher data on the students, that is, achievement in the previous year in the prerequisite subjects, ability scores, etc. The next year, instead of 13 out of 240, we had 81 out of 250. So that illustrates what happens, I believe, when you give teachers the information that they need and want.

I have started at the back to give you one of the results. Now I'll go into some detail on how an individual school got started and how a principal gets started. First of all, I must say this, I got started by coercion. Over a period of time I found myself being invited or directed--I am not sure which--by the superintendent to attend various seminars, to go to various committee meetings, to go on various trips. And he has a saying we are familiar with--at least I am, "find out what it is all about and then brief me."

Anyway, there was a personal interest too, apart from the interest in the machine and I must confess that at this time I couldn't tell you the difference between an IBM 360 or a Honeywell. This wasn't very important to me but I was quite concerned about my own role in the very rapidly changing educational picture. I felt that my own role involved more of facilitation, expedition, and innovation yet I wasn't getting time for this. I felt I just had to have that time. I was being, by the sheer weight of things, forced into the role of a clerk or a data processor myself. I needed information to narrow my areas of decision-making, I needed information in all sorts of areas and I needed to get information to teachers who, too, were dealing with a very quickly changing curriculum and a very flexible arrangement. I needed this information not only because of the curriculum but more because of my belief that we have been paying lip service to this matter of provision for individual differences and I could see that the only way we were going to get out of this was to go into a flexible type of scheduling, break the lock-step of thirty pupils in a 30 by 40 foot box. I realized the complexities of doing this and could see that the only way you could handle this was to move into the use of computers and processing of this data. So I was quite eager to get into it.

Now what do you have to know? The major thing you have to know is not the machines really--we had to know in a general way that they could handle this type of data--but really what we wanted was knowledge of our own system, of the various steps in it. Call it a flow chart or whatever. There was this familiarity with the processing of data and only a very general knowledge of computers. We initiated the program in the school generally as a result of my own knowledge gained from general reading and from viewing other systems. It was not of too much value to go and see computer installations, in fact, after seeing one or two I stopped visiting them because this was something I didn't want to get involved in. It was useful to see what was happening in schools and so I did visit many installations in schools and this was important.

Now to get right down to the nitty-gritty situation, what did we do to institute it? The very first thing I did, before we got involved, was pick three of the youngest, brightest teachers on the staff and talk to them about it and see if they were interested. I then started on a two-pronged arrangement. First of all, I tried to get them to read up on data processing and learn something about it, (in which they went far beyond me). At the same time, I had sessions with them to familiarize them with the school system--what happened within that school, how it was organized in every part of it, and got them to draw out charts of what happened, call them critical path flow charts or just simply organization charts. Then in discussion we set up priorities so that because of the limited funds and because we had among our priorities getting all teachers involved, we decided to work on two aspects, the schedule itself and evaluation, hoping that the first aim would be generally to set up the school so we could go on to other things from the schedule. I might point out at this time the making of a master timetable is a very easy thing to do in any size school if the clerical tasks are undertaken by machine. It is easy without the machine but it may then be time consuming. At any rate, we felt that with this going on we could focus on what comes out after the master schedule, the various print-outs--class listings, timetables, data on students, exceptions lists and so on that you want to use the timetable or school organization to get to. For the evaluation, we wanted to get teachers involved.

Now, because some of you may be concerned that this is very difficult or something different, I am going to take some time to point out that when you get involved with a computer in the production of a schedule you do not change in essence either the flow or the areas in which you have already been making decisions, all you do is get the data processed more quickly, more accurately. The decision-making areas remain exactly the same. For instance, here is the flow of the production of a schedule. First of all, there is a decision that you make as a principal regarding offerings of the school and the data that you want plugged in on the students, what grouping you want, what alternate courses you will set up in your timetable, the general configuration involving the degree of flexibility, external and internal.

The next step, of course, is student choice, which again involves decision-making but on the part of the pupil. Then you come to the mechanical aspect where the machine enters the picture with a tally, simply counting. After you have the tally, then you enter into a decision-making arrangement again. As a result of the tally, how many classes are you going to have, if you have 60 kids in English does this mean two classes or one class or whatever? But you are making decisions at that point. You also, at the same time, are making decisions regarding maximum-minimum size of classes. Now, after you have made those decisions, the next point is a machine point where the machine turns out for you, as a result of the student choices, a conflict matrix. Now a conflict matrix really is a school timetable. Many people think of it as something else but the conflict matrix is, in effect, the school timetable. It is the absolutely logical arrival at a school timetable. Now what you do when you get a conflict matrix back is you impose illogic on a logical situation; that is, you are adding all sorts of personal factors about abilities of teachers, even location of rooms perhaps, but particularly you are dealing with teachers. This is what you impose on the very logical system that was printed out for you. Now, after you have the conflict matrix, then decision-making comes in again with the placement of courses (you decide how much illogic you are going to superimpose on logic). In this instance what you are really doing is melding plant facilities, teachers and pupils. Having made those decisions, you have made up a timetable which you present to your computer centre, and you have a simulation run.

Now this tells you whether you have too many illogical things on the logical framework in which case you might come up with classes of fifty or sixty. Of course, because of the ease with which the computer does things in addition to providing you with this simulation run you get another print-out, by name, of students who have conflicts. So you proceed to make corrections until the problems are solved. In some schools they have five or six simulation runs which I believe private companies like because you pay for each simulation run. If you have two (or one), then you are ready to set your timetable aside, let students change courses during the summer, let them pass courses at summer school, let them enter the school and just in the last three days of August you have this information printed, take it down to your centre, it is run through and there is your timetable. A number of changes are not significant enough in any school to cause a rearrangement of the master schedule, but if some did occur you would just simply do it. That run would become another simulation.

Now what did we get? We got time, we got efficiency, we got data, what is more important we got involvement of teachers by giving them data on the health, achievement, ability of students and so on. We went on from there and the teachers used another computer out at the university for evaluation. The major outcomes of this were, first of all, improvement in the evaluation of students. Teachers saw, through item analysis and error count, that some of the things that they had been doing in making up tests were pretty awful. Their real concern was about the quality of tests then, but more important, their concern about individuals came as a result of teachers being involved in both the timetable construction and the evaluation process. They were ready this year to go into a completely flexible timetable.

Where do we go from here? Basically we will have the same service this year because the North Vancouver centre isn't established. We hope to plug in a bit more information. We hope to preprocess; that is, get the cards, run a group of about 60 to 100 students through on a completely flexible schedule while we maintain, in general, the traditional type timetable, although it isn't traditional because we have introduced much internal flexibility. We do not expect much of a change this year except that the teachers will have more information. Our real hope is to keep moving forward to see what else data processing can do for us.

Point of view of the teacher in the classroom

Mr. John Yusep, Vice Principal,
Victoria Composite High School,
Edmonton Public School District.

In the last two days we have heard a great deal about applications and about data processing, but it was mentioned in our discussion group and I would like to re-emphasize this, that the most important person in this situation is the student. Let us not forget this. I think we should focus, then, on the students. The processing of data is merely a vehicle to improve the learning situation and teaching situation. Let's not forget that.

Let's move into the classroom situation. Before we do that I would like to relate the classroom situation to the Department of Education, the total information system that they are providing. Dr. Reid has looked into the coding of courses or programs, as he indicated. I would like to focus on three courses that we are offering at Victoria Composite High School and throughout the province of Alberta, Data Processing 22 and Data Processing 32. The 22 is offered at the Grade 11 level and the 32 at grade 12. We have two branches here--a programming branch where they actually learn to write programs and then get an opportunity to process them, and a second branch which is the unit record content. I will mention a little more about this later.

One or two points before I get into the details of the courses. The courses that we are offering are of an experimental nature and yet, when we look at the technology that is involved, it is quite possible that we will have a changing content all along because it is moving, it is not a static type of thing. Therefore, this experimental aspect might be with us for some time. At this point, I would like to mention that in developing the data processing courses the Department of Education took the leadership (I was on that committee). We formed an ad hoc committee and we called in the Data Processing Management Association; we called in members of the Computer Society of Canada, Edmonton Local, and also educators. We discussed the content of these courses and came up with a tentative proposal. We also received help in another problem area, in training our teachers, and have had a fair amount of help from the Data Processing Management Association in not only giving teachers' courses, but also in actually lecturing to students who were not able to take the courses that we are offering. I mention this because I feel quite strongly that as educators we are responsible for only part of the education of the students. We feel that industry is also responsible. Schools cannot train specialists for individual jobs. They can give them the broad concepts and then industry will take over and do the job training.

Now, as I mentioned, there are three courses, the first being Data Processing 22, which is offered at the Grade 11 level and is open to all students. This is a general course. We have two courses at the Grade 12 level, Data Processing 32-Unit Record, for which we usually require the students to have Data Processing 22 as a prerequisite, and Data Processing 32-Programming. The Unit Record course includes the key-punch, verifier, sorter, reproducing punch, collator and one or two accounting machines. The Data Processing 32 Programming Course does not require as much equipment, as long as we have a key punch machine. The students will write their programs, students who are taking Data Processing 32-Unit Record will do the punching for them. We process the cards at the Northern Alberta Institute of Technology which is quite handy and we have had tremendous service.

At this point I would like to mention a little about equipment. I think the idea of regional installations is very good for certain operations, for certain applications. But I was pleased to hear that a number of the teachers recommended that we have individual computers in the classrooms. From our experience these young people are used to television, they are used to hearing about the space age, they are familiar with this type of thing. You can talk theory to them to a certain point but sooner or later they want to get their hands on the equipment. They want to get experience with the actual computer and I think we have computers that are small enough so that we could have a computer in some of the classrooms. I don't mean that we should move out and spread computers in every high school in Alberta, because I don't think that is practical. I don't think we know enough of what we can do in a classroom yet, but I do think we should have one or two of them so that we can do a little experimental work.

Now for Data Processing 22, I think I would just like to mention the objectives because I won't go into the scope of the course itself. The objectives as we have listed them are to provide an introduction to unit record and electronic computers, to familiarize students with the terms and routines of data processing and the worker in an automated office, and to acquaint the students with data processing procedures and concepts. I think, also, another very important objective that we have here is to provide career guidance. Some people have a natural aptitude for this type of work and are interested. This is one place where they can find out. Others will find out that they are not ready for this type of work, or that they are not interested and I think this too serves a purpose. This is a general course offered to all students.

We are gradually phasing out Data Processing 32-Unit Record because fewer and fewer installations have unit record equipment, but it is surprising, looking at our graduates, to see how quickly these people get into installations. Our instructor keeps pretty close tab on these people and according to the last report, 75% of last year's class were directly involved in installations.

In Data Processing 32-Programming (this is where students actually write the programs) our main objective is to give them hands-on experience on the equipment. We want to give them the idea of communication with a computer, how do you get information in, what happens to the material once it is in there, and what comes out? This is basically what we are trying to teach them. We are not making programmers out of them but if they like this type of work, we have further training for them, not only at the University but also at the Northern Alberta Institute of Technology.

This is a very brief outline of what is happening in a particular school in a particular classroom. This could spread throughout the province. It is already happening in Calgary and Medicine Hat and a few of the other schools. The future appears unlimited.

CONFERENCE EVALUATION:

ATTITUDES TOWARD DATA PROCESSING IN EDUCATION

Two parallel forms of an attitude inventory toward educational administration were developed on the basis of the Osgood Semantic Differential. Osgood[1] describes this as a method for measuring the meaning of an object to an individual. It may also be thought of as an attitude scale.

The seven-point scale includes bipolar positions such as fair--unfair, clean--dirty, good--bad, and active--passive. The responses of groups and sub-groups can be summated to yield scores that are interpreted as indicating an attitude toward the object being rated.

Form A of the test was completed by the conferees at the beginning of the conference, Form B at the close. Table I indicates the findings in relation to this group and those from the pilot study.

TABLE I

ATTITUDE CHANGE TOWARD DATA PROCESSING

Banff Regional Conference 1968

	Form A		Form B	
	Mean	S.D.	Mean	S.D.
Pilot (N = 79)	68.18	12.89	67.39	13.55
Banff Group (N = 45)	69.98	9.85	77.53	8.79

Several observations can be made about the group and the effect of the conference. The fact that the Banff group, composed of superintendents, school board members, secretary-treasurers, and university personnel, had a smaller standard deviation than did the pilot group indicates that their attitude toward data processing in education was not as divergent as that of the individuals in the pilot study. The latter included mostly teachers and administrators studying at the university. However, the attitude of the Banff Conference participants toward data processing, as shown by the mean score, was not significantly different from that of the pilot study group.

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[1] Claire Selltiz, et al., Research Methods In Social Relations, New York: Holt, Rinehart and Winston, 1966, pp. 380-382.

The most interesting finding was the significant increase in the mean score of the Banff group after the conference. There is support for the contention that a change in attitude did occur. Initially the group scored no higher than the pilot group. However, at the close of the conference the mean score had jumped from 69.98 to 77.53.

To see whether this increase was of a temporary nature, Form A was sent to all the conference participants six months later. The results of this survey are given in Table II. The mean score of the group as a whole had almost returned to the level recorded at the beginning of the conference.

TABLE II

Follow-Up on

ATTITUDE CHANGE TOWARD DATA PROCESSING

Banff Regional Conference 1968

	Pre-test (N = 45)		Post-test (N = 45)		Follow-Up (N = 40)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total Conference Group	69.98	9.85	77.53	8.79	70.68	9.57

Table III presents these data broken down by the three groups represented at the conference: trustees, administrators, and secretary-treasurers. Even though the samples are small the comparison may be revealing.

TABLE III

MEAN SCORES OF THREE GROUPS ON ATTITUDE TOWARD DATA PROCESSING

Banff Conference 1968

Position	Mean Scores		
	Pre-test	Post-test	Follow-Up
Trustee	70.22	78.22	70.75
Educational Administrators	69.90	76.48	71.25
Secretary-Treasurers	58.25	68.25	69.33
Total	69.98	77.53	70.68

It is interesting to note three facts. First, all three groups ended up with relatively the same mean score. Second, all three groups made significant gains toward a more favorable mean score during the conference. Finally, only the secretary-treasurers' group maintained its gain over six months period following the conference, while the other two groups returned to their original attitudinal positions.

D. Friesen

APPENDIX

THE PROGRAM

SUNDAY, APRIL 28: PRE-SESSION

1:00-10:00 p.m.	Room Registration	Banff main desk
1:00- 7:00 p.m.	Conference Registration	Mezzanine
5:30 p.m.	Dinner	Banff Dining Hall
7:30 p.m.	TOPIC: "Orientation to Data Processing" Studio 307 Mr. John Yusep, Vice Principal Victoria Composite High School Edmonton Public School Board	
8:30 p.m.	Planning Session - Group Leaders and Recorders	

THE PROGRAM

MONDAY, APRIL 29: THE MORNING SESSION

8:00 a.m.	Breakfast	Banff Dining Hall

FIRST GENERAL SESSION

Studio 307

9:00-10:30 a.m.

Chairman: Dr. David Friesen

Opening Remarks: Dr. Fred Enns, Acting Head
Department of Educational Administration
University of Alberta

Keynote Address: Dr. R. L. Bright, Associate Commissioner
Bureau of Research
U.S. Office of Education

10:30 a.m.	Coffee Break	
11:00-12:00 a.m.	Small Group Interaction Sessions	(rooms to be announced)
12:30 p.m.	Lunch	Banff Dining Hall

THE PROGRAM

MONDAY, APRIL 29: THE AFTERNOON SESSION

SECOND GENERAL SESSION

Studio 307

1:30-2:30 p.m.	Chairman: Dr. David Friesen Response to Small Group Questions: Dr. R. L. Bright Associate Commissioner Bureau of Research U.S. Office of Education	
2:30 p.m.	Coffee Break	
3:00-3:30 p.m.	Report of a Survey - Data Processing in Canadian School Districts Mr. David Hemphill, Advanced Graduate Student Department of Educational Administration University of Alberta	
3:30 p.m.	Developing Data Processing in a School District Mr. John Kusnir, Coordinator of Educational Data Processing North Vancouver School District	
6:00 p.m.	Dinner	Banff Dining Hall
7:30 p.m. and 8:15 p.m.	Film Showings: The Living Machine The Control Revolution	(Rooms to be announced)
9:00-11:00 p.m.	Social Hour	Library

THE PROGRAM

TUESDAY, APRIL 30: THE MORNING SESSION

8:00	Breakfast	Banff Dining Hall

THIRD GENERAL SESSION

Studio 307

9:00-10:00 a.m.	Chairman: Dr. Chester Bumbarger	
	Address: Dr. Frank Farner, President Federal City College Washington, D. C.	
10:00-10:30 a.m.	Buzz Groups: Audience	
10:30 a.m.	Coffee Break	
11:00-12:00 a.m.	Questions from Buzz Groups and the Floor: Dr. Frank Farner	
12:30 p.m.	Lunch	Banff Dining Hall

THE PROGRAM

TUESDAY, APRIL 30: THE AFTERNOON SESSION

FOURTH GENERAL SESSION

Studio 307

1:15 p.m. Chairman: Dr. Chester Bumbarger

Panel Presentation: Use of Data Processing in School Systems in Western Canada

Panel Moderator: Dr. F. J. Gathercole
Director of Education
Saskatoon Public Schools and Collegiates

A Provincial View: Dr. J. E. Reid
Coordinator of Research
Alberta Department of Education

A Central Office Perspective:
Dr. L. Sampson
Director of Education
West Vancouver School District

A School Principal Viewpoint:
Mr. Allen Stables
Supervising Principal
Delbrook Senior Secondary School
North Vancouver School District

A Classroom View: Mr. John Yusep
Vice-Principal
Victoria Composite High School
Edmonton Public School Board

2:45 p.m. Closing Comments and Evaluation:
Dr. Chester Bumbarger

3:00 p.m. Coffee and Adjournment

DISCUSSION GROUPS

Group A

Nelson A. Allen
(Discussion Leader)

Bernard Chandler
(Recorder)

James W. Downey
Thomas H. Gleig
S. J. Graham
Dr. J. R. Stan Hambly
Dr. Olaf Larson
N. Lucyshyn
Dr. R. E. Rees
D. Sawada
Allen Stables
Harold D. Stafford
R. E. Stephenson
B. J. Strain
Mike Von Zuben

Group B

Robert A. Kimmitt
(Discussion Leader)

Don Nissen
(Recorder)

Hal Chalmers
E. J. Christie
Paul Clancy
Dr. W. Dushenski
J. Heuvel
John Kusnir
C. G. Lawrence
Dr. J. M. LeBoldus
G. T. Molloy
Dr. A. Proudfoot
G. A. Victor Thomson
John Yusep

Group C

S. J. Hovdebo
(Discussion Leader)

Frank Coulter
(Recorder)

R.A.E. Bolduc
Murray D. Campbell
G. H. Dawe
Dr. F. Enns
L. J. Fournier
Dr. W. Knill
Benjamin Lowther
W. G. Manning
C. S. McKenzie
W. G. Pechey
T. Ryles
D. P. Todd
I. G. Wright

Group D

Dr. D. A. Girard
(Discussion Leader)

John Hudson
(Recorder)

Dr. J. Bicknell
George H. Brent
M. A. Carpenter
G. H. Davison
K. G. Haise
Lex Henderson
Mrs. D. Lynas
E. Marriott
L. L. Ouellette
John D. Oviatt
W. Podiluk
Dr. L. P. Sampson

Group E

Wm. E. Lucas
(Discussion Leader)

Les Milne
(Recorder)

H. R. Bidwell
L. H. Blackbourne
P. Coleman
Dr. I. Dent
Dr. F. J. Gathercole
Dave Hemphill
John J. Hill
A. V. MacLeod
W. D. McEwen
Dr. J. E. Reid
F. M. Riddle
L. A. Riederer
J. N. Robinson

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* These three books, taken together, cover most of the above subjects.

1968 BANFF REGIONAL CONFERENCE

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